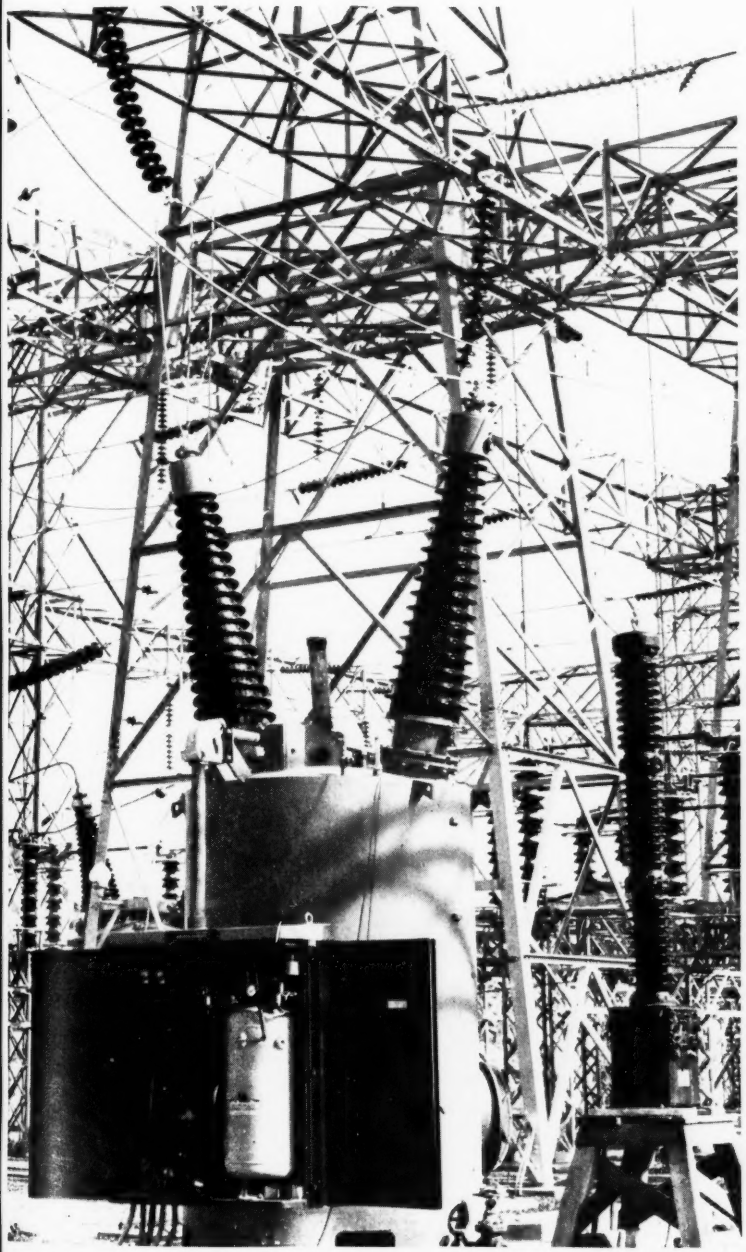
HNOLOGY DEPARTMENT

Power Generation

INCLUDING Power Plant ENGINEERING ESTABLISHED 1896

PUBLIC LIBRARY
MAY 13 19[illegible]
DETROIT



APRIL, 1948

Engineers' Preview 7
Helpful Bulletins 35
New Equipment News 40
What Leaders Say 51
Power Plant Improvement at Stanley Furniture Company 52
By Denard L. Gusler
Regenerative Reheating Possibilities of Steam Turbines 56
By W. E. Caldwell
A Mechanical Rectifier 58
How to Make Industrial Steam Plants Pay with Today's High Cost 62
By Byron A. Lininger
How to Construct Overfire Jets for Your Plant 64
Standard Builds 1250-psi Topping Plant for Whiting Refinery-I 66
By D. A. Monro and A. T. Milbrook
Atomics
Where Are We Heading in Atomic Development? 70
By A. W. Kramer
The Practical Engineer 72
Engineers Are a Healthy Lot
So You're Going to Take an Examination!
By Cyril F. Greene
Thread Cutting in the Lathe
By Carl Thomas
Letters and Comments
Questions and Answers
Cutting Fluids Chart
New Engineering Books 96

• • •

COVER: THIS IS A 3-CYCLE OIL CIRCUIT BREAKER WHICH INTERRUPTED A 7,500,000-KVA SHORT CIRCUIT ON THE 230-KV BUS AT GRAND COULEE DAM DURING A TEST LAST SUMMER. THIS SHORT CIRCUIT INVOLVED THE ENTIRE OUTPUT OF THE SIX 108,000-KVA GENERATORS TOGETHER WITH BACK FEED OVER SIX 230-KV TRANSMISSION LINES FROM BONNEVILLE AND THE NORTHWEST POWER POOL.

The Magazine That Helps Men Responsible for Generation of Steam, Electricity and All Other Forms of Power Supply

SPRINGDALE

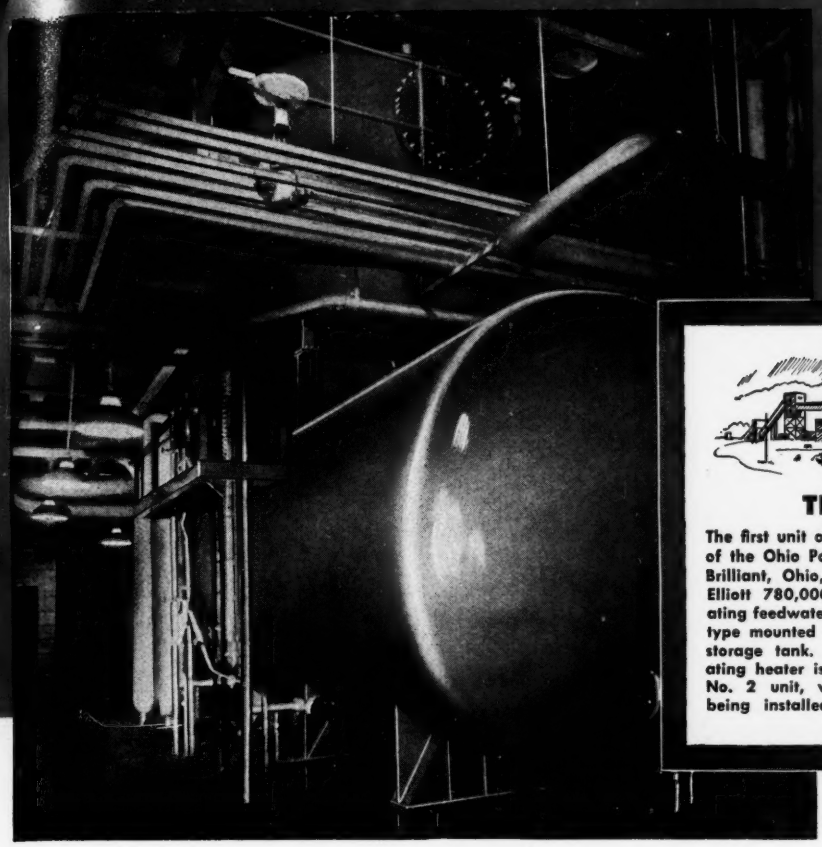
In addition to the 1,000,000-lb-per-hr deaerating heater in its new No. 7 extension, illustrated, the Springdale Station of West Penn Power Company has an Elliott deaerator which has been serving faithfully for 22 years — naturally a factor in the selection of the new deaerating heater.

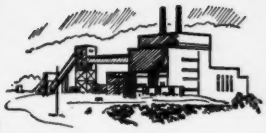
Big, up-to

MISSOURI AVE.

Two Elliott 300,000-lb-per-hr deaerating feedwater heaters serve units 6 and 7 of the Atlantic City Electric Company. The photo, of the newest of these installations, shows the vertical deaerating heater with its vent condenser. The horizontal storage tank is located beneath the heater, as in the Springdale and Tidd units. This station is the first to use steam at a temperature of 1000 F.

Elliott





TIDD

The first unit of this new station of the Ohio Power Company, at Brilliant, Ohio, is served by an Elliott 780,000-lb-per-hr deaerating feedwater heater of vertical type mounted upon a horizontal storage tank. A similar deaerating heater is on order for the No. 2 unit, which is currently being installed.

-p-to-date stations agree on Deaerating Heaters *by Elliott*

It is a grave responsibility to mount guard against corrosion over the millions of dollars worth of equipment represented in plants such as those shown here. It is a responsibility which is not placed lightly.

In the three fine stations represented here, this vital task is entrusted to Elliott deaerating feedwater heaters. These units deliver in the required quantity, water free of dissolved oxygen, heated to saturated steam temperatures. The ability of these units to serve satisfactorily is based firmly upon sound experience gained through years of application, and stemming from Elliott Company's pioneering in the early history of deaeration.

Whether for an important utility, or for a comparatively small industrial power plant, Elliott enginers are prepared to evaluate attendant conditions and to supply deaerating heater capacity conforming to installation requirements. Let us discuss it.

Deaerating heater bulletin on request.

N-990

OMPANY
aerator and Heater Department
JEANNETTE, PA.
ts at: JEANNETTE, PA. • RIDGWAY, PA.
RINGFIELD, O. • NEWARK, N. J.
STRICT OFFICES IN PRINCIPAL CITIES

STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS •

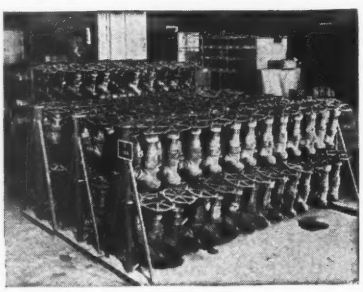
valve values

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

JOBBERS EVERYWHERE STOCK EDWARD VALVES



Ends capped, oiled and hung off the floor for protection against thread damage and dirt, these Edward forged steel valves are part of stock in an important Gulf coast supplier. In foreground, Edward 7500 lb Fig. 158 valves; in background, Fig. 2688.

Edward valves are stocked by distributors and oil field stores in all parts of the country. Some of the larger Edward valves are, of course, built on order, but all Edward forged steel valves, and many cast steel stop, check, non-return and other valve types are available out of stock.

If your jobber doesn't have the valve you want, he can get it for you and the chances are good that shipment can be made immediately.

Valve Values, Impactor and EValthrust are registered trade marks of Edward Valves, Inc.

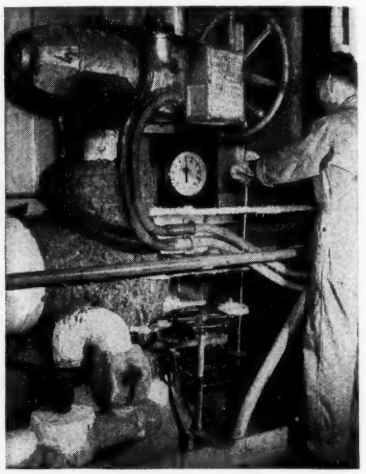
Pressure Drop Tests Take to Field

EDWARD LABORATORY FINDINGS CHECKED

Research into the characteristics of flow and the reduction of pressure drop has been a continuing Edward laboratory project for many years.

Recently Edward engineers checked their laboratory findings with a series of country-wide field tests, believed to be unparalleled in flow research, in large central stations operating under considerably different conditions.

Edward angle non-return valve as tapped for field test in 1300 lb 920 F midwestern central station.



Temporary insulation covers Edward motor-operated angle valve during in-service pressure drop tests

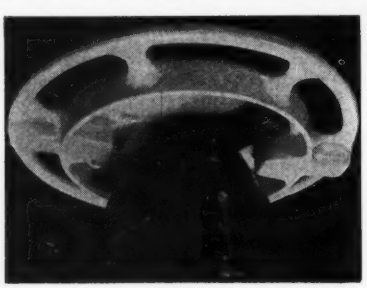
To make the tests, standard valves were drilled and tapped so that pressure recording gages could be installed at vital points in the path of flow. Stress analysis was made concurrently through strain gages affixed to the body of the valves.

Test results, coupled with laboratory data accumulated through the last decade, have guided the redesign of many types of Edward valves with reduction of pressure drop of up to 30 per cent.

IMPACTOR HANDWHEEL, CLOSURE INDICATOR AIDS TO OPERATOR

For years, the Edward Impactor handwheel has been the most popular method for manual operation of large valves. Usually attached to a valve with patented EValthrust ball bearing yoke, it has simplified closing big valves against high loads in close quarters.

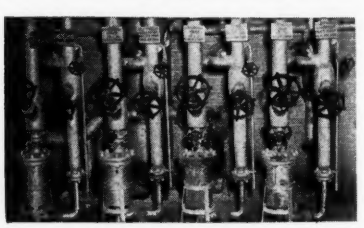
Now many large Edward valves are also equipped with a new, high-visibility closure indicator to show the position of the valve stem at a glance. In combination, the Impactor handwheel, EValthrust yoke bushing and Edward closure indicator are great helps to the operator.



Edward Fig. 2688's Used on Trap Lines

A good all-purpose forged steel globe valve is the Edward Fig. 2688, an O.S. & Y. valve, and its inside screw companion, Edward Fig. 2698.

A good example of the many piping uses for this valve series is this condensate and trap line hook-up on the



reheat system of a big new central station in north central United States.

The Edward inclined stem construction in small globe valves has many advantages, not only in lower pressure drop, but in reduced wear through freer flow, and, as the illustration shows, piping flexibility where a battery of valves must be installed in limited space.

EDWARD builds cast and forged steel globe and angle stop, gate, non-return, blow-off, feedline stop-check, INTEX (integral seat), integral bonnet UNIVALVES, relief, hydraulic, gage, straight-through valves and strainers for power, petroleum, marine, industrial and technological services.

EDITORIAL STAFF

ANDREW W. KRAMER
Editor
CHESTER R. EARLE
Managing Editor
THOMAS E. HANSON
Associate Editor
CHARLES W. BEHRENS
Associate Editor
EARL R. NOREN
Assistant Editor
RALPH E. TURNER
Consulting Editor
RICHARD H. MORRIS
Contributing Editor

Published Monthly by
TECHNICAL PUBLISHING CO
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

KINGSLEY L. RICE, *President*
EDWIN C. PROUTY, *Vice President*
WALTER PAINTER, *Vice President*
ARTHUR L. RICE, JR., *Treasurer*
CHARLES S. CLARKE, *Secretary*
RALPH E. TURNER, *Editorial Advisor*
JOHN O. AARVOLD, *Prod. Manager*

DISTRICT MANAGERS

CHICAGO: Charles S. Clarke
Arthur L. Rice, Jr.
53 W. Jackson Blvd., Chicago 4, Ill.
Phone: Harrison 0824

NEW YORK: Oscar Wilds
860 Graybar Bldg., New York 17, N. Y.
Phone: Caledonia 5-3779

PHILADELPHIA: Charles A. Loney
602 Washington Ave.
Palmyra, N. J.
Phone: Riverton 9-1285-R

CLEVELAND: A. H. Van Duyn
681 Union Commerce Bldg.
Cleveland 14, Ohio
Phone: Cherry 1377

PACIFIC COAST: Roy M. McDonald & Co.
Roy M. McDonald, Mgr.
564 Market St.
San Francisco 4, Calif.
Phone: Garfield 8966
Robert Aland, Mgr.
639 So. Wilton Place
Los Angeles 5, Calif.
Phone: Drexel 2590
Harry Abney, Mgr.
Terminal Sales Bldg.
Seattle 1, Wash.
Phone: Main 3860

WASHINGON, D. C., OFFICE
Business Press News Bureau
National Press Bldg.
Washington, D. C.

Subscription Information—Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00. Changes of address should give both old and new address and reach us by 15th of month to be effective with following month's issues. The Annual Index is furnished as a part of the December issue.

Power Generation

April, 1948

VOLUME 52—NUMBER 4

Engineers' Preview 7
Helpful Bulletins 35
New Equipment News 40
What Leaders Say 51
Power Plant Improvement at Stanley Furniture Company 52
By Denard L. Gusler
Regenerative Reheating Possibilities in Steam Turbines 56
By W. E. Caldwell
A Mechanical Rectifier 58
How To Make Industrial Steam Plants Pay With Today's High Cost — *By Byron A. Lininger* 62
How to Construct Overfire Jets For Your Plant 64
Standard Builds 1250-psi Topping Plant for Whiting Refinery-I 66
By D. A. Monro and A. T. Milbrook
Atomics 70
Where Are We Heading in Atomic Development?
By A. W. Kramer
The Practical Engineer 72
Engineers Are a Healthy Lot
So You're Going To Take an Examination!
By Cyril F. Greene
Thread Cutting in The Lathe
By Carl Thomas
Letters and Comments
Questions and Answers
Cutting Fluids Chart
New Engineering Books 96
Construction News 142

Contents of back issues of Power Plant Engineering and Power Generation will be found in Industrial Arts Index on file in Public Libraries.

Copyright, 1948, by Technical Publishing Company.

Entered as second class matter February 10, 1948 (original entry May 1, 1908), at the Post Office, Chicago, Illinois, under act of March 3, 1879.

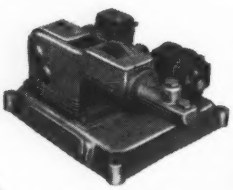
CHEMICAL TREATMENT METERING PUMPS

for Every Power Plant

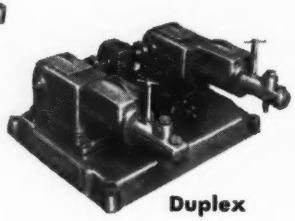
PLUNGER TYPE PUMPS FOR HIGH PRESSURES

DIAPHRAGM TYPE PUMPS FOR LOW PRESSURES

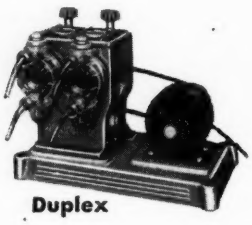
FROM THE SMALLEST JOB



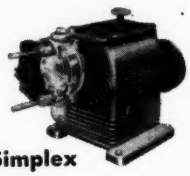
Simplex



Duplex



Duplex

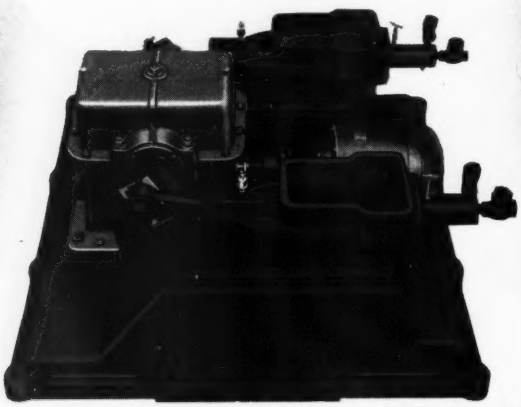


Simplex

Also available in Triplex and Quadruplex designs

Also available in Triplex and Quadruplex designs

TO THE LARGEST HIGH PRESSURE INSTALLATION



COMPLETE INTERCHANGEABILITY OF PARTS IN EACH GROUP

NEW MODELS NOW AVAILABLE

• HEAVIER FRAMES • LARGER WRIST PINS • EXTRA HEAVY NEEDLE BEARINGS AND PUSH RODS • STUFFING BOXES SPECIALLY DESIGNED FOR INTERCHANGEABLE STANDARD PACKINGS OR TEFLON SEALS

Write for new Brochure SM 122 and Bulletin CAT.

% PROPORTIONEERS, INC. %

Write to %PROPORTIONEERS, INC.%, 46 Codding Street, Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

ENGINEERS' PREVIEW

"BOUNCING PUTTY," the G-E silicone laboratory curiosity, which has been seeking a user for the past three years, is finally going to work. The United States Rubber Co. announces that the material is now being incorporated as the center of golf balls. The famous silicone material which can be pulled like taffy, broken with a quick snap, or bounced like a ball, will be used in all the company's top grade golf balls, together with a new type of electronic winding. Although the bouncing putty was created more than three years ago, as chronicled in this magazine, only practical uses for the material to date have been in the field of physiotherapy, where it has been used by crippled veterans to help strengthen their hands, and in a new Levelmatic device that Blake Industries of Detroit manufactures to keep furniture legs level.

★ ★ ★

SEA EYED as source of power. No, that's not a typographical error; that's a headline from our own *Chicago Sun and Times.* Translating the headline writers' language into English, we find that somebody has been eye-ing —that is, considering—the sea as a source of power. The someone, not specified in the newspaper story, is proposing to build a power plant in French West Africa that will use the temperature differences between sea water at the surface and at lower depths, a scheme first employed some years ago in an experimental plant off the coast of Cuba by the French scientist, Georges Claude. As engineers will remember, the idea is that relatively warm sea water at the surface is pumped through a heat exchanger in which a vacuum is created by circulating water pumped from great depths at a much lower temperature. The exchange of heat between the two is supposed to cause the relatively warm water to flash into low-pressure steam, which will drive a steam turbine—they hope. It is proposed to build a plant of this type for a capacity of 7000-kw to serve the Ivory Coast territory in French West Africa, where 2,000,000 people live on 115,000 acres of fertile land. This territory is reported to be rich in natural resources and capable of sufficient industrial development to permit manufacturing a number of the things needed by its population—if they could only get some power.

★ ★ ★

ENERGY EQUIVALENT of 30,000,000 to 40,000,000 barrels of oil a year can be provided in electric power by June, 1953, under the recently revised construction schedules of the Bureau of Reclamation for hydroelectric facilities on western irrigation projects, according to Secretary of the Interior J. A. Krug. This, he claims, not only would advance Western river basin development, but also ease pressure on critically short fuels by putting to use potential hydroelectric energy now wasting down Western rivers. The revised reclamation construction schedules contemplate the addition of 2,948,100 kw of generating capacity in the West by June 30, 1953, including 120,000 kw of steam generating capacity necessary to the operation of the Central Valley Project in California.

HOW FAST does sound travel in superheated steam? And why is that important? Well, it is important, for one thing, because it leads to pure scientific knowledge about the velocity of sound in gases. Another reason is that even a slight trace of any impurity in a gas will alter materially the velocity of sound in that gas. By using this fact, ultrasonics may be developed as a means of detecting traces of air in steam, for example. In mixtures of gas, changes in composition can be detected by methods described in the paper.

Briefly, these methods involve the development of an apparatus in which a quartz crystal, vibrated electrically at its natural frequency, is used as a sound source to set up a series of standing waves in a vertical cylinder filled with steam. The frequency of the sound source and the length of the standing waves are measured with high accuracy by simple and convenient methods. In this work a crystal was used that had a natural frequency of 575,000 cycles per second at room temperature.

The frequency was measured with an accuracy of one part in 200,000, while the length of the sound wave was measured to one part in 2,000. Since the acoustic velocity is the product of these two factors, the actual velocity of sound in steam was measured with high accuracy. This, incidentally, varied from 1649.68 ft per sec at 24.69 psi to 2019.45 at 99.69 psi and temperatures ranging from 300 to 700 F. The electrical equipment required is not complicated and only 0.3 v were needed to keep the crystal vibrating in superheated steam.

Since the purity of steam itself is a matter of much concern to power engineers, some very practical applications of this device may be expected in this field as time goes on, as well as in related fields and in the realm of pure science. Full details of this interesting development were given by James Woodburn, Associate Professor, Rice Institute, before the 1947 ASME meeting.

★ ★ ★

HYDROSPHERE, a new hydrodynamic bearing, was discussed at the 1947 annual ASME meeting in a paper by M. C. Shaw and C. D. Strang, Jr., both of MIT. This is a fitted, spherical bearing, which has been found to operate hydrodynamically when subjected to large values of thrust or radial-thrust load. Careful study of this bearing shows that the usual wedge-shaped oil film in the direction of motion of the moving bearing surface is not present. However, a wedge does exist perpendicular to the direction of motion. This bearing is similar to the Kingsbury and Michell type bearings, in that the shape of the oil film changes automatically so as to carry the applied load effectively. Like the Kingsbury and Michell bearings, the hydrosphere does not depend upon a machine generated surface to provide the minute indication of the fluid wedge. The hydrosphere is angularly self-aligning and may operate in either direction of rotation when bath oiled or pressure fed. The bearing has performed satisfactorily under a combined radial-thrust load.

EVER NEED to know where you can have testing done or have certain types of research work carried out on various products used in your business or industry? Among other things, do you ever need to know what commercial testing laboratories are in your immediate vicinity? Or, do you need to know whether or not college laboratories are doing any kind of testing work or can do any for you? If there is a college laboratory anywhere near you, is it doing work for state, municipal and public institutions? Will any of this work help you in your field?

To answer such questions as these, the National Bureau of Standards, U. S. Department of Commerce, has just published a directory of commercial and college laboratories. The Bureau, as everybody knows, makes tests and carries out investigations for other government agencies in accordance with the laws. The Bureau does not, however, make tests for private individuals if other laboratories can do the work with sufficient accuracy. That is the reason why the Bureau has attempted to compile this list.

The list also indicates the types of commodities these laboratories are willing to test for commodity acceptance or other purposes. Information is given concerning 220 commercial laboratories with 80 branches or offices. Also, a list is included of the laboratories of 189 colleges that are used not only for purposes of instruction but also, to a considerable extent, for research and testing work. The types of work they can do and the classification of the commodities they are prepared to investigate are given. The directory is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 30 cents per copy. It is identified as National Bureau of Standards miscellaneous publication M-187, superseding publication M-171.

★ ★ ★

USABLE alone or with other materials as reinforcement for sheet, laminated or shaped plastics, Modigliani glass veil has special advantages, adding strength, texture and color without weight, thickness or bulk. This, only unwoven glass fabric available in superthin construction (2.5 mils), is a refinement of flexible glass fabric, with apparent one-direction stretch achieving multi-direction ability when of sufficient width.

★ ★ ★

VARIOUS REFERENCES have recently been made in these pages to uses of supersonic vibration, not only in such applications as the precipitation of carbon black, but also in possible application in the combustion process itself. The latter remark has aroused the curiosity of many readers, who have asked us just what this means. All we can tell you at the moment is that reports have come to us of one laboratory now experimenting with supersonic vibrations to hold pulverized coal in suspension in air during combustion, thus improving the entire process by producing more complete combustion of the fuel. We have also been discussing this possibility with a consulting engineer of our acquaintance who has been following it with great interest. For the present, however, that is all we are permitted to say about it, primarily because the experiments in question have not yet led to any definite conclusions, although they look extremely encouraging. As soon as definite information is available, you may be very sure we will pass it on to you.

TINY BLOWTORCH uses dry chemical fuel in tablets, a wholly-new principle that eliminates spilling, evaporating or explosion. Weigh a few ounces, is held between thumb and finger, always ready for use, needs no preheating, equipped with brass cup to hold tablets, brass tube supporting cup and adjustable clip. Air-cooled handle is nickel-plated steel, mouth tube clear, sanitary, flexible plastic, only gentle blowing is necessary. Super-Fuel tablets burn 10 minutes, giving intense heat, doing clean work without residue. Temperatures above 2000 deg F are produced. Super Jet blowtorch is suitable for soft or silver soldering, light brazing, annealing or hardening small work.

★ ★ ★

TUFF-TRED safety stair nosings with non-slip abrasives and no ridges, can be installed with all types of resilient flooring, rabbeted into wood floors, placed in concrete or terrazzo stairs. Square or round edge designs with treads of differing colors.

★ ★ ★

TO CREATE bends in pipe portable Roll-A-Bend bench tool has a roller that is easily adjusted to fit the mandrel being used. Any bend to 180 deg can be made in one operation. Mechanically operated by one man but can be converted to power operation. Weight 340 lb with all mandrels. Will bend ½, ¾ or 1 in. pipe through 8, 12, 15, 18 or 24 in. mandrel sizes and 1¼ and 1½ to a variety of sizes.

★ ★ ★

GROSS VOLUME of $2,500,000 in research business for the 1946-1947 fiscal year has just been reported in its annual report for 1947 entitled, Partners in Research, by Armour Research Foundation of Illinois Institute of Technology. The report shows a 34.6 increase over 1945-1946. Just to give some indication of the type of things on which the foundation is working, which may some day be reflected in actual engineering equipment, here are a few of its activities:

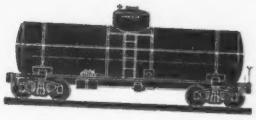
Of interest and ultimate benefit to the general public as a whole is the work of the A-C Network Calculator Laboratory and Riverbank Acoustical Laboratories, the National Registry of Rare Chemicals, the Precision Gage Laboratory, the Ohmite Laboratory of Precision Electric and Magnetic Measurements. The foundation itself sponsors research in such things as the field of moderate and very high pressure phenomena, fluid flow and heat transfer in artificially roughened pipes, and vacuum treatment of metal.

Among the industrial research projects carried on by the foundation under the sponsorship of various industrial organizations, the following are typical: Development of Cutting Fluids; Development of Diaphragm Valves; Performance of Rotary Pumps; Stress Studies in Flue Gas Stacks; Volume Changes in Masonry Lingings of Steel-Jacketed Stacks; Refractory Coatings for Metals; Engine Deposits; Fly Ash Studies; Bakery Sponsored Study to Improve Pie Crust; Drying Methods; The Deposition of Solids on Turbine Blades at High Pressure; a number of studies in lubrication and lubricating oils, factory noise elimination systems, V-Belts, etc. The foundation is continuing its research on the magnetic wire recorder and on a great variety of electronic and electrical devices.

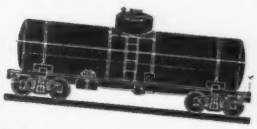
NOW IS THE TIME
to improve boiler efficiency

Even if your old combustion equipment "works" . . . there are *three good reasons* why you should replace it NOW with up-to-date Enco Burners or install modern Enco Streamline Baffles.

Although your present equipment may have been the "last word" when it was installed, advances in the design of burners, atomizers, and baffles in the last 15 or 20 years have resulted in far greater efficiency.



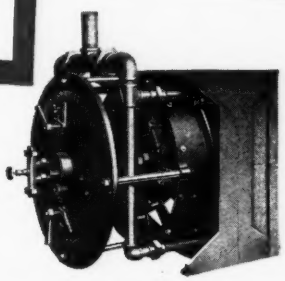
Oil is scarce. New Enco Fuel Oil Atomizers and Enco Streamline Baffles will conserve fuel oil through greater overall combustion efficiency.



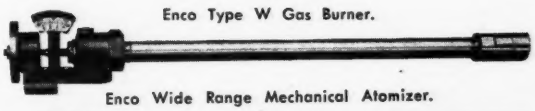
Rising fuel costs may be offset by the savings realized when up-to-date Enco appliances replace your old equipment.

For instance, Modern Enco Steam Atomizers will work more efficiently with less atomizing steam — while Enco Wide Range Mechanical Atomizers provide wider load range and better efficiencies throughout the entire load range. Enco Streamlined Baffles have boosted steam output and improved boiler performance. Every detail of Enco Gas Burners, Oil Burners, Electric Ignition Systems for pulverized coal burners . . . contributes to better combustion, higher output.

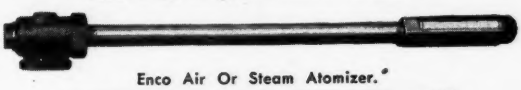
Investigate the advantages of replacing your old equipment with modern Enco appliances. Do it *now* . . . a letter or telephone call to your local Enco Representative will bring you full information.



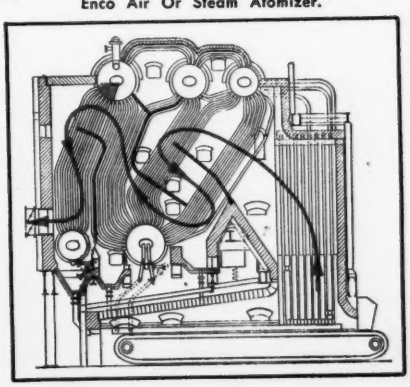
Enco Type W Gas Burner.



Enco Wide Range Mechanical Atomizer.



Enco Air Or Steam Atomizer.

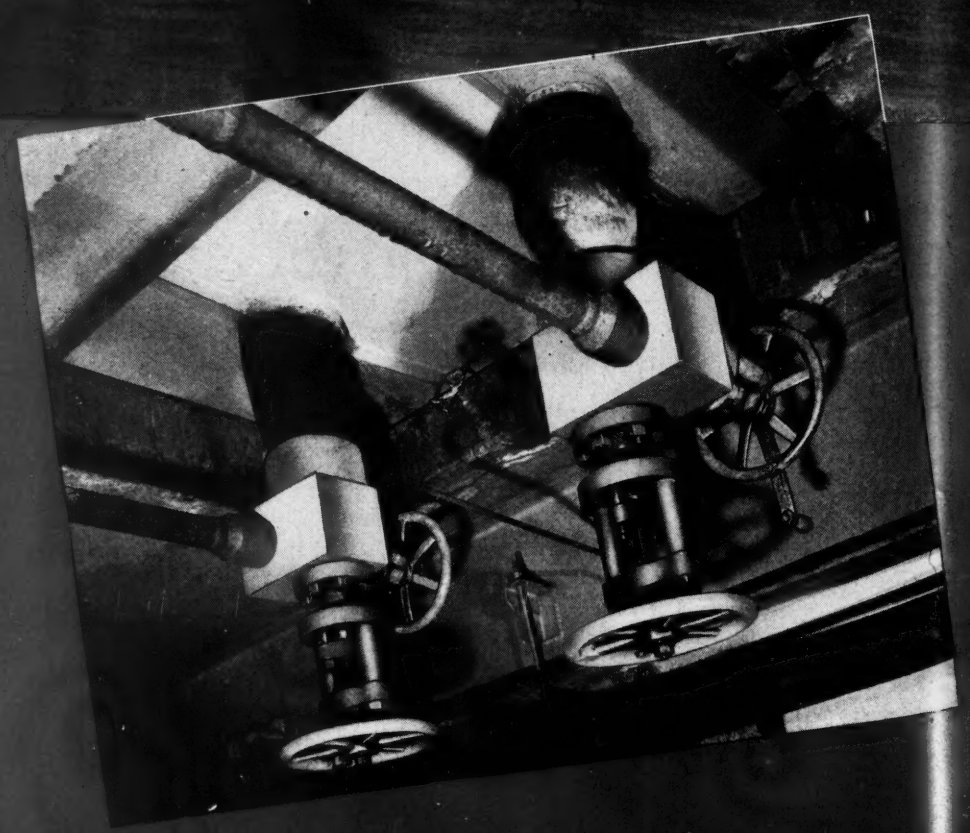


THE ENGINEER COMPANY

Canadian Representative

REPRESENTATIVES IN:

Public Service (N.J.) *Chooses* YARWAY



Burlington, N. J., Station of the Public Service Electric and Gas Company. Four boilers at this plant, and two at Public Service's Marion Station are each equipped with two Yarway Unit Tandems. Steam pressure boiler 1350 psi, turbine 1250 psi. Temperature 950° F. Output, each boiler, 550,000 lbs per hour; high pressure turbines, 125,000 KW each.

YARWAY BLOW-OFF VALVES

UNIT TANDEMS

FOR HIGH PRESSURE BLOW-DOWN SERVICE

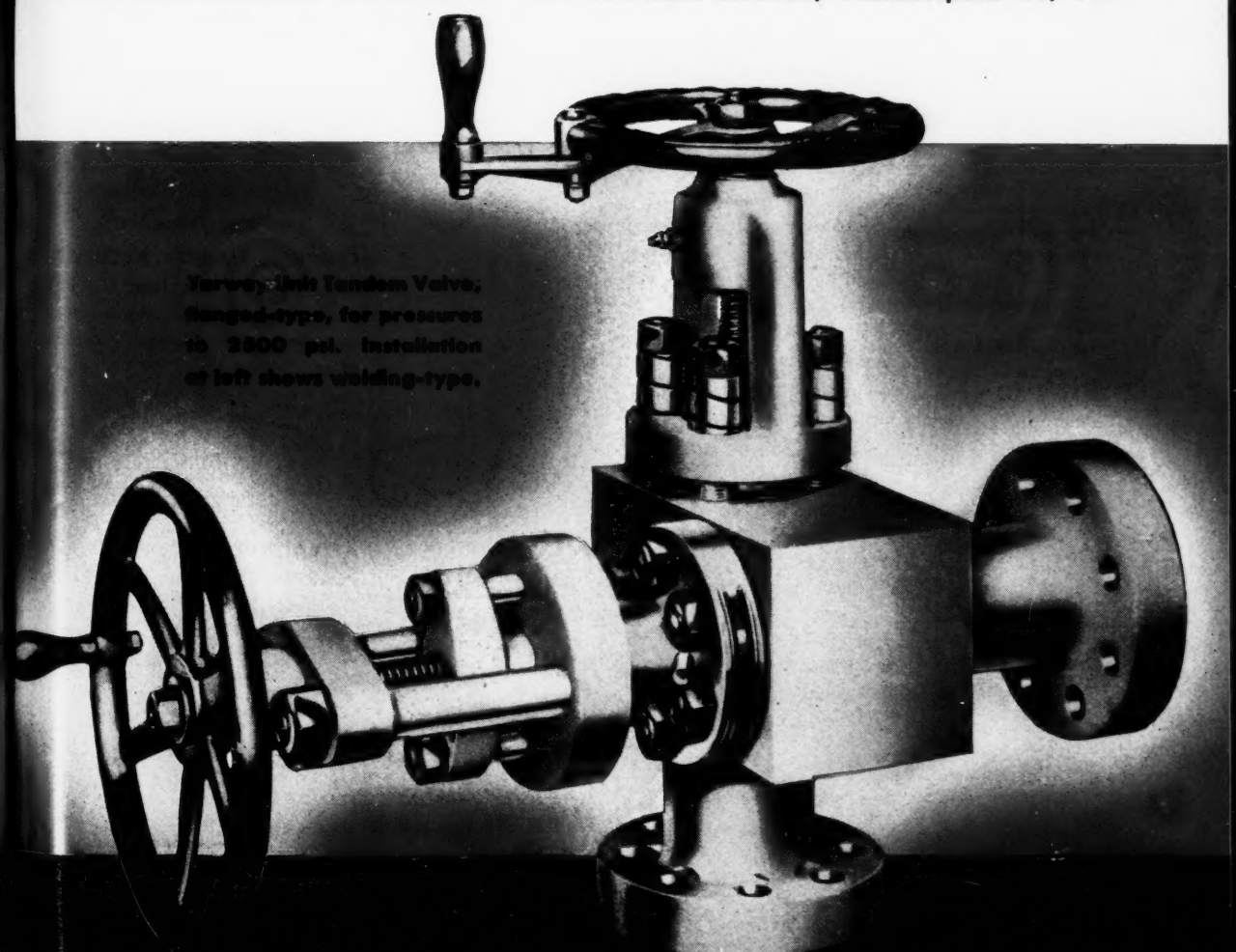
Why has the Public Service Electric and Gas Company of New Jersey, like so many other leading utilities, selected Yarway Unit Tandem Blow-Off Valves for their high pressure boilers? The answer is simple—*proved performance.*

Yarway Unit Tandems have proved themselves unequalled in service throughout all industries on pressures from 400 to 2500 psi. This tandem is a combination of the Yarway Hard-Seat* Valve (next to boiler for blowing) and the famous Yarway Seatless Valve (for sealing)—both contained in a one-piece forged steel body. This rugged construction eliminates the interconnecting flanges, bolts and gaskets required in bolted tandem designs, making a trim, compact unit.

Nearly 40 years of laboratory and field experience concentrated on blow-off valve requirements, makes Yarway a logical source of supply for your next blow-off valves. Write for Catalog B-432 for pressures up to 2500 psi . . . Catalog B-424 for lower pressures.

** Seats furnished either separate or integral.*

YARNALL-WARING COMPANY • 114 Mermaid Avenue, Philadelphia 18, Pa.



Yarway Unit Tandem Valve, flanged-type, for pressures to 2500 psi. Installation at left shows welding-type.

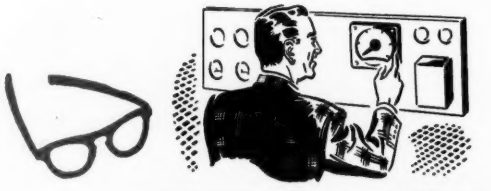
the new look in GE instruments

.. is more than meets the eye!

- LONGER SCALE . . . FOR GREATER READABILITY
- SPRING-MOUNTED JEWELS . . . FOR
- UNIT DESIGN . . .

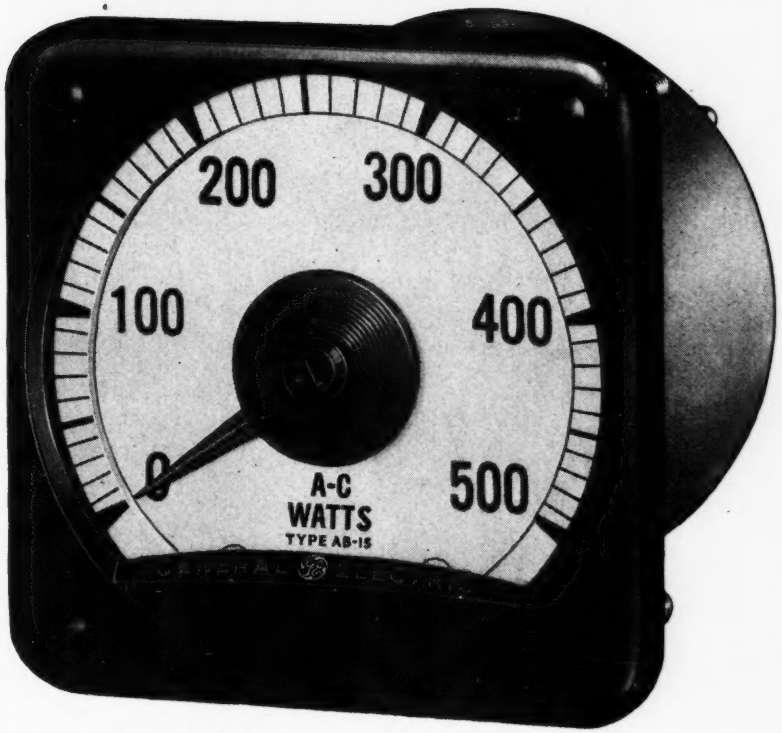
GENERAL ELECTRIC announces the *first* completely new, completely post-war line of switchboard instruments—*the new long-scale line.* Here are instruments embodying improvements in construction and operation that were learned during the war years—improvements that will lend added readability and increased attractiveness to any switchboard installation.

Much attention has been given to details . . . from the standpoint of *appearance, readability,* and *mechanical design of the mechanisms.* Take a look at these features and we are sure you'll agree that these are instruments you'll want to specify for all new installations.



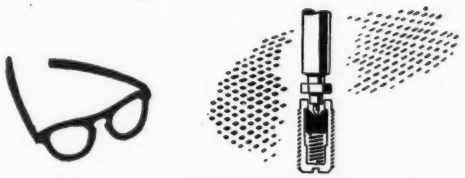
QUICKER, MORE ACCURATE READING on the long, 7.1-inch scale, spanning 250 degrees, with all figures reading laterally instead of on a curve.

ATTRACTIVE, MODERN, APPEARANCE in the new black Textolite* cover, with circular mask covering the mechanism at center of dial, serving to emphasize only scale and pointer.

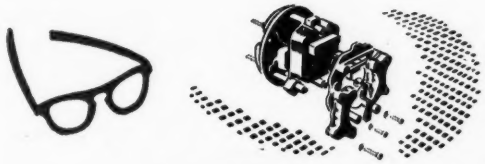


GREATER STRENGTH

FOR EASE AND ECONOMY OF SERVICE



STURDINESS—Jewels spring mounted to minimize possibility of accidental damage to pivots.



EASE AND ECONOMY OF SERVICING assured by new "unit" design . . . entire moving-element assembly can be removed without disturbing calibration.

OTHER POPULAR FEATURES OF THE NEW LONG SCALE LINE ARE—

Reduction of behind-the-panel depth . . . potential circuit resistance built within the instrument in most instances. *Economy of space* . . . small size—only 4¼ inches square—permits mounting of five instruments side-by-side on a panel only 24 inches wide. *1-per-cent accuracy* . . . antiparallax scale and pointer plus antiglare glass permit readings from any reasonable distance or angle.

And those are only a few of the features available to you in these new instruments. Couple them with the many other refinements found in all G-E switchboard instruments and you have a line unexcelled in quality and performance . . . instruments that will do the job better, quicker, and more efficiently.

When you need switchgear or additional switchboard instruments, *insist* on the G-E long-scale line and be *sure* of the best. Ask your nearest G-E sales office for complete information on these AB-15 (a-c) and DB-15 (d-c) instruments. . .

A-c Ammeter	**A-c Voltmeter**	**A-c Wattmeter**
Varmeter	**Power-factor Meter**	**Frequency Meter**
Synchroscope	**D-c Ammeter**	**D-c Voltmeter**

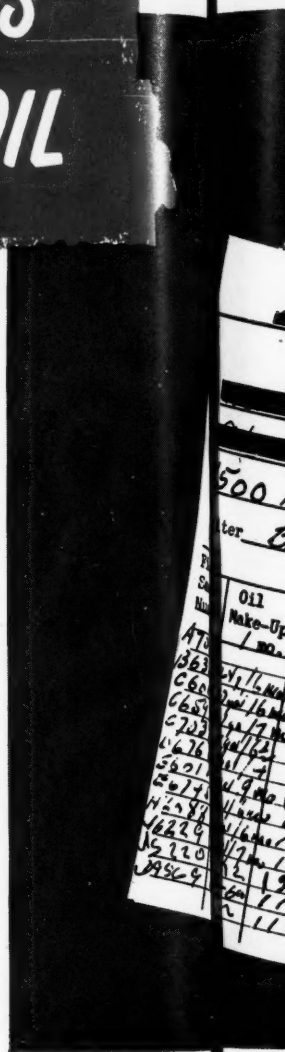
Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

602-116

20 YEARS OF RECORDS ON INHIBITED TURBINE OIL



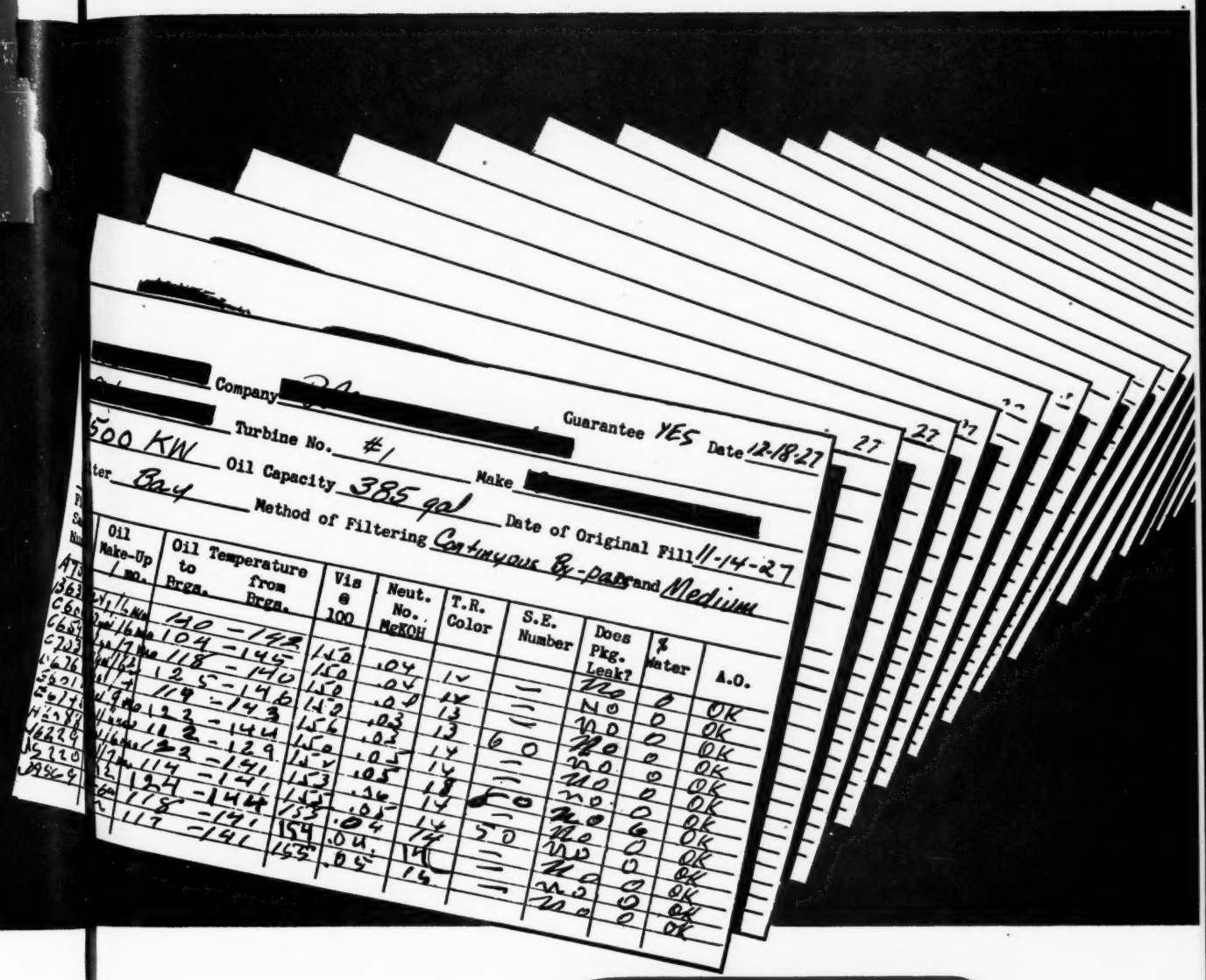
What this experience means to you...

Since the first fill, 20 years ago, of oxidation-inhibited, guaranteed Nonpareil-Turbine Oil, records have been kept of its operation in each installation. At Standard Oil Laboratories, oil samples are checked periodically for acidity, demulsibility, viscosity, and other significant qualities. No other oil has so long or so complete a record of performance.

These records furnish ample proof that Nonpareil lives up to its guarantee "not to increase in acidity above 0.15 mg KOH/gm." Further, according to these records, Nonpareil does not need replacing even after 20 years of service. Nor does it ever need to be removed from the turbine for treating or resting.

A Standard Oil Lubrication Engineer can give you names of Nonpareil users, perhaps near you, where you can check these facts for yourself. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

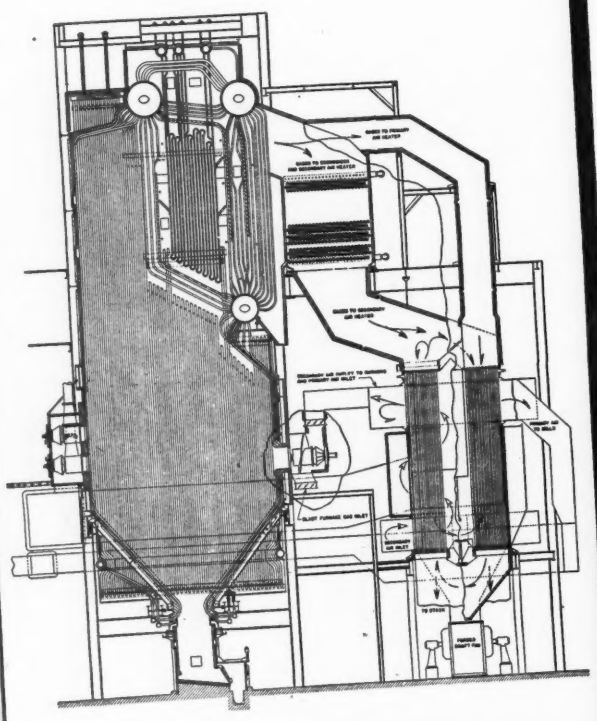
STANDARD OIL COMPANY (INDIANA



NONPAREIL
TURBINE OIL

STANDARD OIL COMPANY (INDIANA)

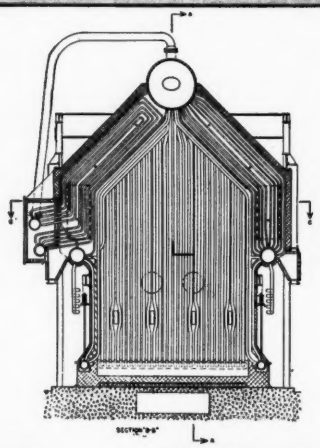
The steam generating capacity



Steam Capacity . . . 500,000 lb. per hour
Efficiency . . . . . 88.50 per cent

Every dollar you spend for fuel is a financial transaction with a potential return of so much steam.

There is just so much heat available in the fuel you buy. The problem is to transfer as much of this heat into steam as modern engineering is capable of doing.



Steam Capacity . . . 77,500 lb. per hour
Efficiency . . . . . 85 per cent

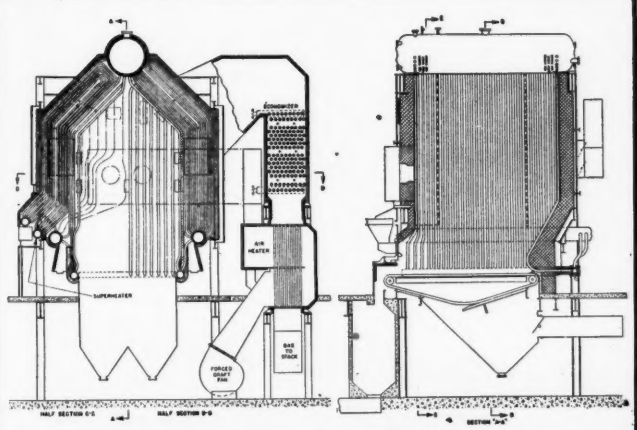
FW FOSTER

# of your Dollar

Look at the table and see how near Foster Wheeler can bring you toward realizing a dollar's worth of steam for a dollar's worth of fuel. Then look to a leader when you are ready to install a new steam generating unit in your plant.

Foster Wheeler Corporation
165 Broadway, New York 6, New York.

NUMBER OF UNITS	CAPACITY LB. PER HOUR	PER CENT EFFICIENCY
2	640,000	86.04
1	400,000	83.07 (gas) 87.55 (oil)
1	375,000	85.18
1	325,000	85.11
4	216,000	84.
1	300,000	86.89
2	300,000	84.81
1	500,000	88.50
1	385,000	88.40
2	250,000	87.05
1	250,000	83.80
2	215,000	84.24
4	120,000	86.88
2	175,000	82.17
1	77,500	85.



Steam Capacity . . . 75,000 lb. per hour
Efficiency . . . . . 85 per cent

WHEELER

ENGINEERING PROGRESS REPORT # 12

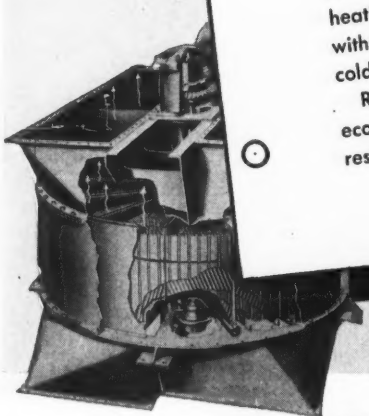
LJUNGSTROM AIR PREHEATER

CORROSION-RESISTANT ALLOY FOR HEATING ELEMENTS

The removable cold end of the Ljungstrom heating element (upper left) and sections from which the cold end has been removed for purposes of illustration.

In the Ljungstrom, the replaceable cold end is made from a special corrosion-resistant alloy that reduces maintenance and replacement. In addition, the heating elements at the cold end are made from heavier gage metal to withstand the impact of the mass soot blower and lengthen the life of the cold end.

Replacement of the cold end of the heating surface is rapid, easy and economical. Standard equipment on all new installations, corrosion-resistant cold ends can be applied to older Ljungstrom air preheaters.

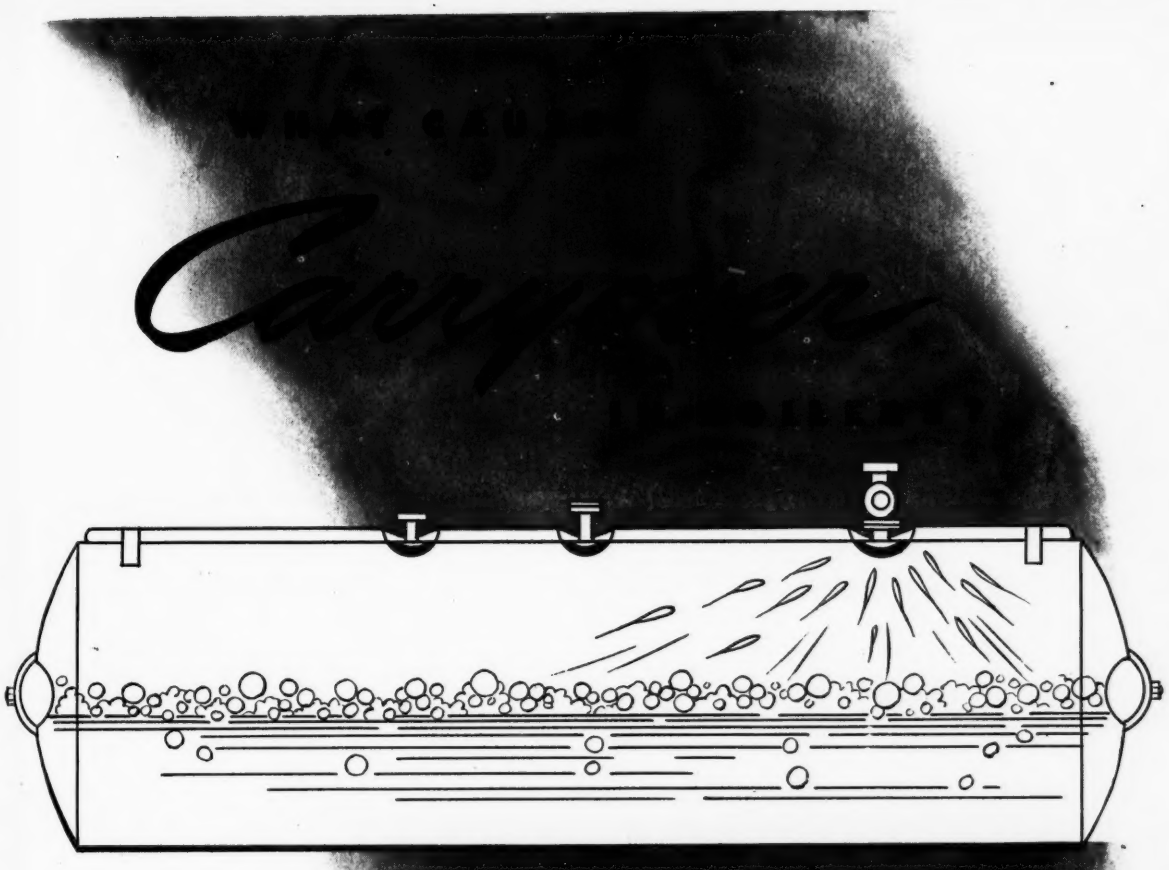


THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.



Drew Power Plant Chemicals

for the prevention of

difficulties encountered in the use of

Our engineers are always at your service.

E. F. DREW & CO., INC.

15 E. 26th STREET, NEW YORK 10, N.Y.

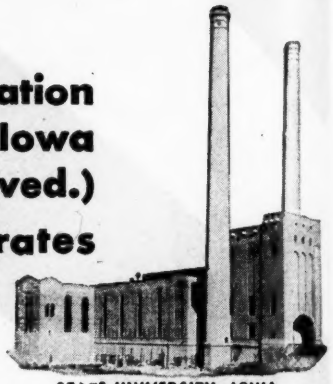
COMPLETE SERVICE BY DREW ENGINEERS IS AVAILABLE IN KEY CITIES OF THE U. S., CANADA, BRAZIL, ARGENTINA, MEXICO AND PUERTO RICO.

POWER DREW CHEMICALS

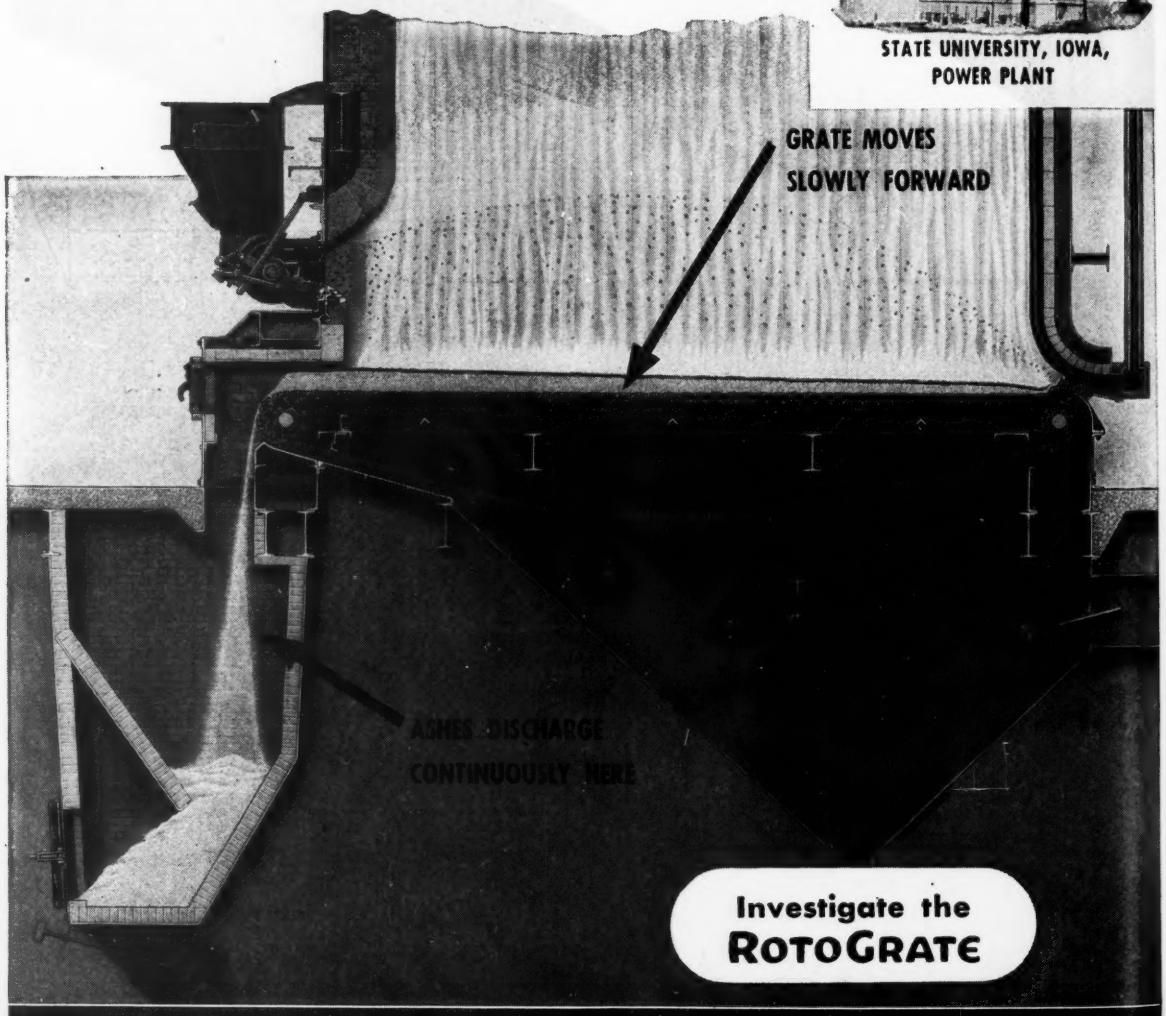
TEN YEARS' EXPERIENCE WITH DETROIT ROTOGRATE STOKER

First RotoGrates were placed in operation at the State University of Iowa at Iowa City in 1938. (Second contract now received.)

Nearly Four Hundred Detroit RotoGrates are now installed or on order.



STATE UNIVERSITY, IOWA, POWER PLANT



Investigate the ROTOGRATE

DETROIT STOKER COMPANY

Detroit has a record of success in building the original spreader stokers with forward moving, continuously cleaning grates.

Detroit RotoGrate Stokers:

- Burn wide range of fuel with low maintenance.
- High CO_2 maintained. Use preheated air.
- Operate with comparatively thin fuel bed. Low combustible loss in the ash.
- Have no difficulties with clinkers or slagging.
- Require little power for operation.
- Are installed in a variety of plants here and Abroad.
- A standard of comparison.

The RotoGrate is the original spreader stoker with FORWARD MOVING GRATES that slowly and continuously discharge the ash at the front. The RotoGrate development followed the building of hundreds of Detroit RotoStokers because:

(1) Higher burning rates are demanded for the narrower furnaces of Modern Steam Generators.

(2) Detroit RotoGrate Stokers give continuous and dependable operation for *long periods* with low quality, high ash Bituminous coal or Lignite.

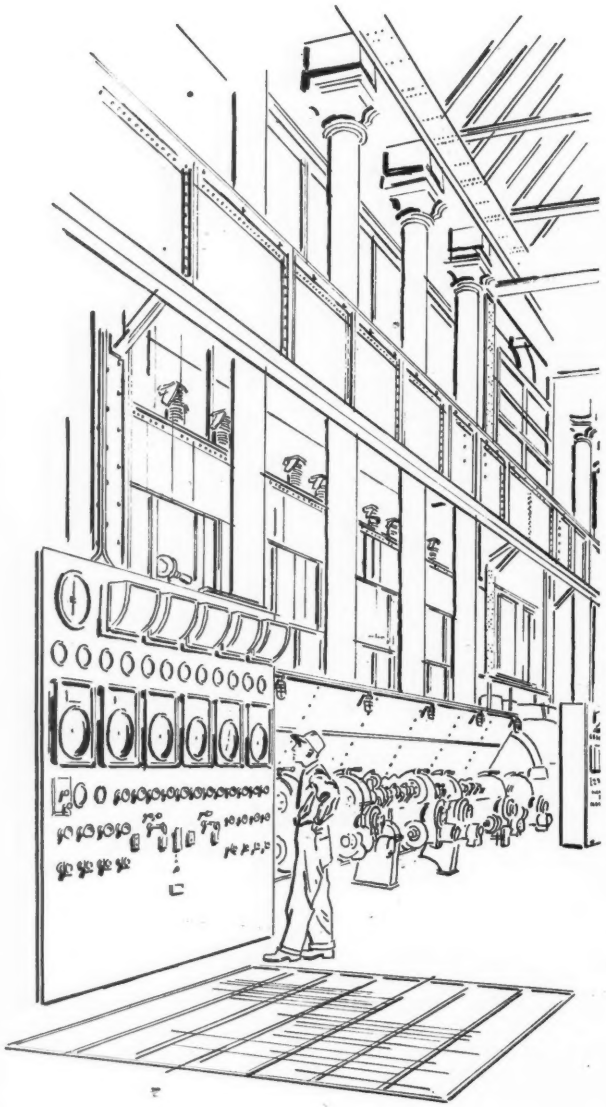
RotoGrates have revolutionized the industry . . . are installed with practically all boiler types. Experience gained as stoker engineers since 1898 is available to you for Consultation without obligation. Write or wire for Bulletin No. 6024.

BREWERIES
DISTILLERIES
ELECTRICAL EQUIPMENT
STATE AND GOVERNMENT PLANTS
HOSPITALS
PUBLIC SERVICE PLANTS
COAL MINING
AUTOS AND ACCESSORIES
IMPLEMENTS
FOOD PRODUCTS
UNIVERSAL ACCEPTANCE
MUNICIPAL POWER PLANTS
CHEMICALS AND DRUGS
RAILROADS
STEEL MILLS
EDUCATIONAL INSTITUTIONS
PAPER MILLS
MACHINERY MANUFACTURERS
RUBBER MANUFACTURERS

DETROIT ROTOGRATE STOKER

GENERAL MOTORS BUILDING
DETROIT 2, MICHIGAN
Works at Monroe, Michigan • District Offices in Principal Cities

Treatment problems multiply



THE "fork of the road" in industrial water treatment is the point at which water is directed on the one hand toward applications in which it will be used as water and on the other hand to applications in which it will be converted into steam.

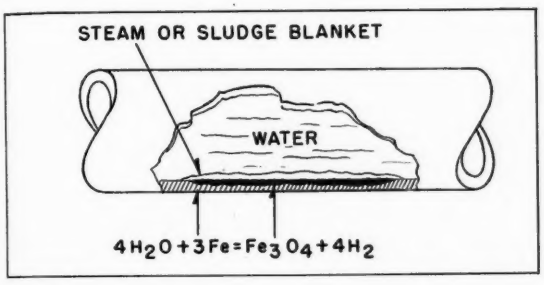
Each group of applications has its own peculiar problems, but the problems which arise when water *changes phase*, particularly at high temperatures and pressures, are far more difficult and complex, presenting an almost infinite variety of intricate cross-relationships.

The very fact of evaporation means that the total quantity of impurities in the remaining water tends to increase, for make-up water is inevitably less pure than the steam it replaces. At high temperatures and ratings, the chemical and solubility relationships of such impurities are big factors in determining whether boiler tubes will continue to function or become clogged with deposit.

Relatively harmless sodium carbonate, for example, is changed to caustic soda, liberating its carbon dioxide, which will accelerate

HAGAN
HALL
BUROMIN
CALGON

when water *changes phase*



corrosion wherever condensation occurs.

Oxygen also is an ever-present problem. Modern methods of deaeration may reduce *dissolved* oxygen in feed water to as little as one millionth of one percent—but *water itself is 88.9 percent oxygen.* All of this oxygen is actually available for combination with the steel of the boiler tubes,and combination becomes more rapid as temperature increases.

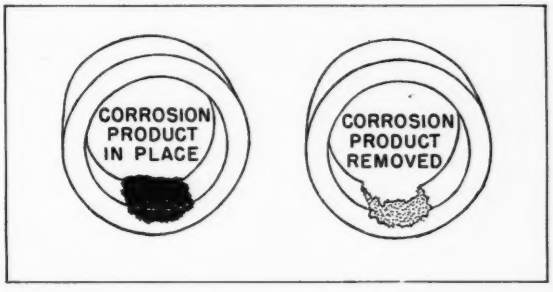
Fortunately, this attack on the steel by the water can be limited to an insignificant amount, though it cannot be completely prevented. Optimum control requires careful and continuous maintenance of various chemical equilibria, to prevent the development of conditions, such as excessive causticity at evaporative surfaces, which are favorable to iron oxide formation.

There is no stock answer to these problems and to the dozens of inter-related problems which arise in processes in which water is evaporated, or steam condensed.

Hall Laboratories is prepared to recommend procedures which, taking all factors into account represent the most economic and efficient solution *in your specific situation.*

Every problem concerning the use of water in industry comes within the scope of Hall Laboratories. Correspondence concerning such problems is invited.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.



HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

REPUBLIC CONTROLS

Are Being Specified

FOR ALL SIZES OF BOILERS AND ALL TYPES OF FUEL FIRING

TYPICAL INSTALLATIONS

SPREADER STOKERS

ALLIS-CHALMERS MFG. CO.
Springfield, Ill.
2 boilers: 68,000 lb./hr. each: 160 lb.

ALLIED CHEMICAL & DYE CO.
Chicago, Illinois
1 boiler: 45,000 lb./hr.: 125 lb.

BUICK AVIATION PLANT
Melrose Park, Illinois
1 boiler: 90,000 lb./hr.: 175 lb.

CHICAGO & NORTHWESTERN R. R. CO.
Green Bay, Wisconsin
2 boilers: 25,000 lb./hr. each: 125 lb.

HUBINGER CO.
Keokuk, Iowa
1 boiler: 150,000 lb./hr.: 500 hp.

CLINTON ENGINEERING WORKS
Clinton, Tenn.
3 boilers: 50,000 lb./hr.: 175 lb.

NORTHWESTERN YEAST CO.
Chicago, Illinois
1 boiler: 338 hp.: 140 lb.
2 boilers: 253 hp.: 140 lb.

MARSHALL CANNING CO.
Marshalltown, Iowa
1 boiler: 40,000 lb./hr.: 160 lb.

KRAFT FOODS
Albany, Minn.
2 boilers: 338 hp. each: 160 lb.

CHAIN GRATE STOKERS

ADAMS & WESTLAKE CO.
Elcart, Indiana
2 boilers: 500 hp. each: 125 lb.

BETHLEHEM STEEL CO.
Bethlehem, Pa.
4 boilers: 600 hp. each: 160 lb.

THE BERYLLIUM CORP. OF PA.
Temple, Pa.
2 boilers: 22,500 lb./hr. each: 145 lb.

CHICAGO, NORTHWESTERN R. R.
Chicago, Illinois
3 boilers: 45,000 lb./hr. each: 160 lb.

CLINTON PRODUCTS CO.
Clinton, Iowa
2 boilers: 25,000 lb./hr. each: 200 lb.

GAS FIRED

BEECH AIRCRAFT CORPORATION
Wichita, Kansas
2 boilers: 180 hp. each: 100 lb.

GULF POWER COMPANY
Pensacola, Florida
1 boiler: 230,000 lb./hr.: 875 lb.

GENERAL TIRE & RUBBER CO.
Waco, Texas
3 boilers: 16,000 lb./hr. each: 190 lb.

MATHIESON ALKALI WORKS, INC.
Lake Charles, La.
1 boiler: 420,000 lb./hr.: 925 lb.

MISSISSIPPI POWER CO.
Hattiesburg, Mississippi
1 boiler: 230,000 lb./hr.: 875 lb.

TIDEWATER ASSOCIATED OIL CO.
Avon, California
2 boilers: 100,000 lb./hr. each: 250 lb.

ABERCRAMBIE-HARRISON OIL CO.
Sweeney, Texas
4 boilers: 100,000 lb./hr. each: 250 lb.

PULVERIZED COAL

BELTON MILLS
Belton, South Carolina
1 boiler: 60,000 lb./hr.: 250 lb.

BOECKELER ASSOCIATES
Trenton, Michigan
1 boiler: 528 hp.: 125 lb.

GEORGIA POWER COMPANY
Harryat, Georgia
1 boiler: 600,000 lb./hr.: 975 lb.

HARTFORD CITY PAPER COMPANY
Hartford City, Indiana
1 boiler: 80,000 lb./hr.: 325 lb.

CLINTON ENGINEERING WORKS
Oliver Spriggs, Tenn.
1 boiler: 750,000 lb./hr.: 1375 lb.

N. Y., N. H. & HARTFORD R. R. CO.
Cos Cob, Conn.
1 boiler: 150,000 lb./hr.: 325 lb.

PRATT & WHITNEY
East Hartford, Conn.
2 boilers: 20,000 lb./hr. each: 175 lb.

OIL FIRED

BAY REFINING CORP.
Bay City, Michigan
1 boiler: 350 hp.: 245 lb.

FITCHBURG GAS & ELEC. LIGHT CO.
Fitchburg, Mass.
2 boilers: 120,000 lb./hr. each: 200 lb.

PHILADELPHIA NAVY YARD
Philadelphia, Pa.
2 boilers: 130,000 lb./hr. each: 175 lb.

CITIES SERVICE REFINING CORP.
Lake Charles, La.
4 boilers: 140,000 lb./hr. each: 250 lb.
2 boilers: 200,000 lb./hr. each: 250 lb.

KADOTA FIG ASSOCIATION
Merced, California
1 boiler: 505 hp.: 155 lb.

HIGGINS AIRCRAFT, INC.
New Orleans, La.
2 boilers: 75,000 lb./hr. each: 180 lb.
2 boilers: 40,000 lb./hr. each: 180 lb.

UNDERFEED STOKERS

EDWARD G. BUDD MFG. CO.
Philadelphia, Pa.
3 boilers: 100,000 lb./hr. each: 150 lb.

CHEVROLET MOTORS
Bay City, Michigan
1 boiler: 600 hp.: 150 lb.

INDEPENDENT PNEUMATIC TOOL CO.
Aurora, Illinois
1 boiler: 300 hp.: 300 lb.

THE OLD QUAKER CO.
Lawrenceburg, Indiana
2 boilers: 500 hp. each: 160 lb.

REO MOTORS, INC.
Lansing, Michigan
1 boiler 40,000 lb./hr.: 260 lb.

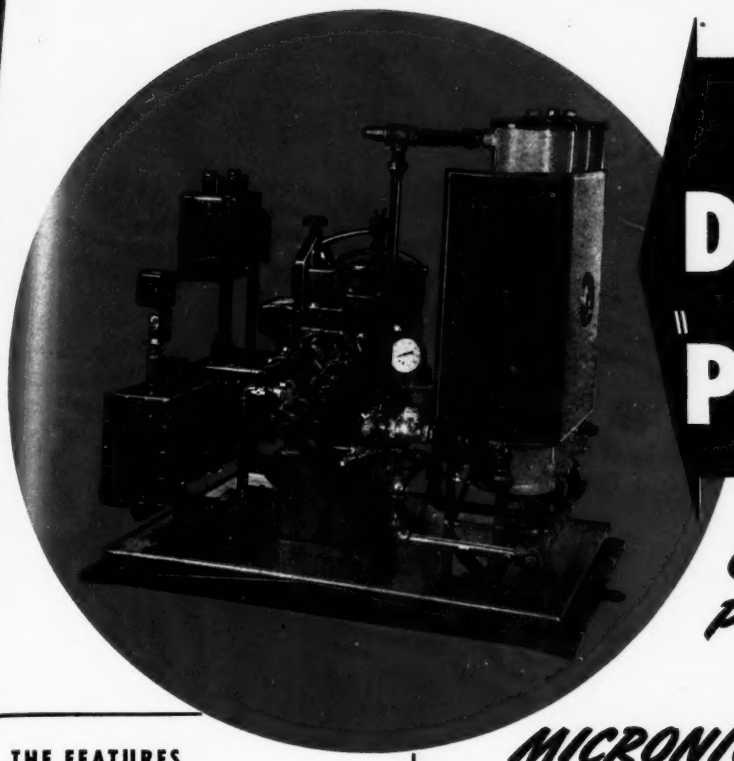
U. S. FINISHING CO.
Norwich, Conn.
1 boiler: 40,000 lb./hr.: 165 lb.

UPJOHN COMPANY
Kalamazoo, Michigan
1 boiler: 40,000 lb./hr.: 160 lb.

COLUMBUS ASF DEPOT
Columbus, Ohio
1 boiler: 26,000 lb./hr.: 90 lb.

WRITE FOR DATA BOOK NO. S-21

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois



The DE LAVAL "Puri-Filter"

CENTRIFUGAL PURIFICATION + MICRONIC FILTRATION

THE FEATURES OF THE "PURI-FILTER"

1. Removes dirt and water by centrifugal force
2. Filters out harmful carbon
3. Does not remove valuable additives
4. Cleans oil at moderate temperature
5. Speeds up inspection—crankcase is cleaner
6. Minimizes ring sticking
7. Increases bearing life
8. Saves labor—long runs without bowl cleaning
9. Increases oil life
10. No dirt...carbon...or water

What the "PURI-FILTER" IS

The DeLaval "Puri-Filter" combines the DeLaval "Uni-Matic" Oil Purifier which centrifugally removes most solid impurities and all water, and Fram "Filcron" Filters which, in cleaning the Diesel lubricating oil, also restore the oil to a translucent amber color. The De Laval "Puri-Filter" leaves the lubricating oil *clean* and *dry* . . . provides the *maximum* in protection for every engine. It is complete with dirty-oil and clean-oil pumps, and is piped ready to operate.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

FOR DIESEL LUBRICATING OIL

...the VU Unit

... designed for industrial plants adopted by public utilities

When the manufacturer of many of the world's largest central station boilers applies its experience to a unit for industry, it is not surprising that utilities, themselves, should adopt the design.

That's the year by year record of the VU Unit - verified again in 1947 by *utility* orders and installations with a total capacity of more than 6,500,000 lb of steam per hr. There could be no stronger endorsement than this, for steam is the prime product of a central station, where efficiency depends on economical steam generation – continuously.

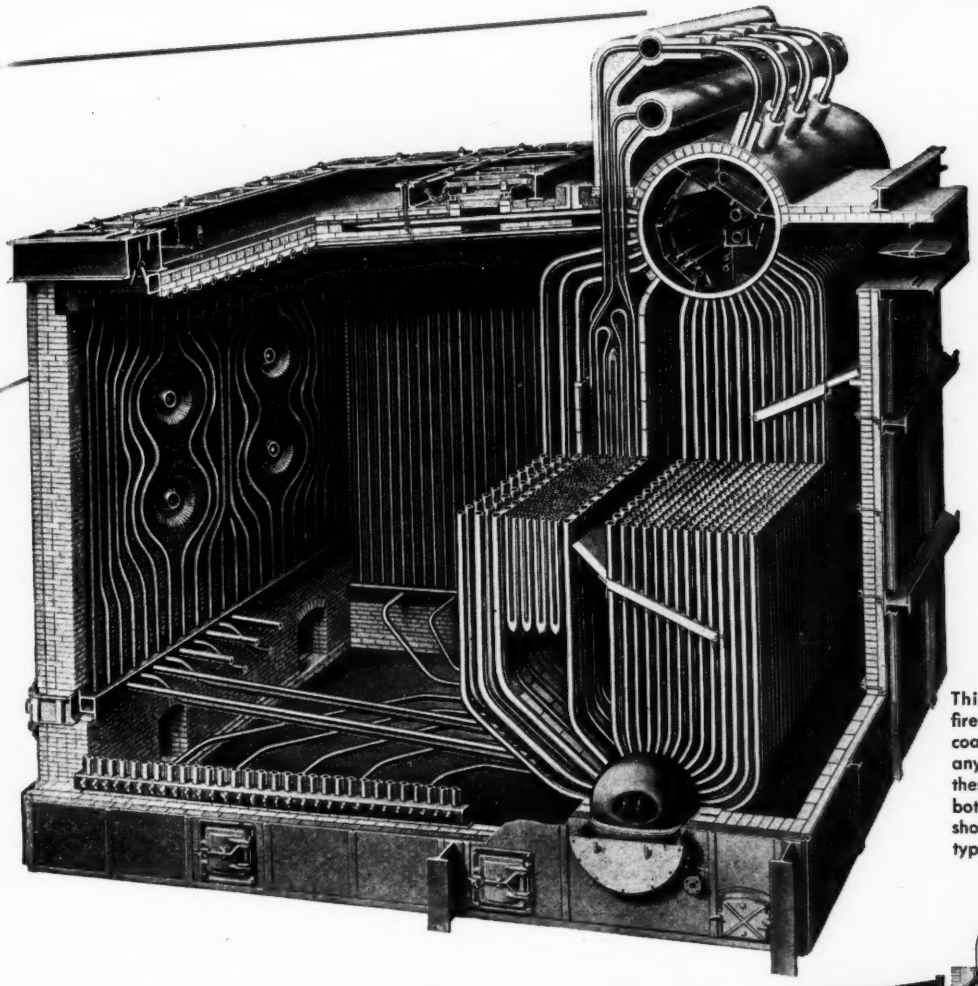
Think what central station performance could mean in your plant – high availability, low maintenance, quick response to extreme fluctuations in load, dry steam at all ratings and efficiency as high as 88 per cent. All this, and more, at a first cost which reflects the economies of standardized design.

And there is good reason for calling the VU the Versatile Unit, for it is available in capacity ranges from as low as 20,000 lb of steam per hr to 350,000 lb of steam per hr; design pressures may vary from approximately 160 to 1000 psi, with steam temperatures up to 900 F and beyond.

Moreover, your location with respect to

COMBUSTION

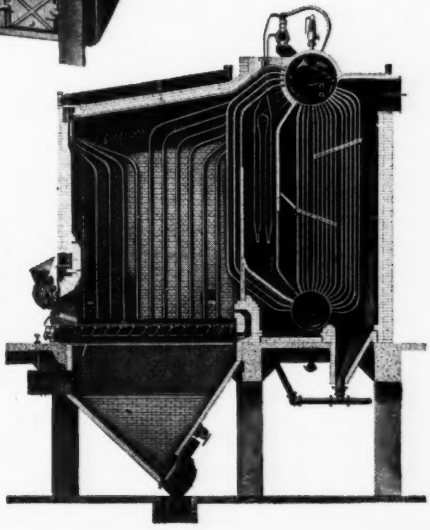
C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



This unit may be fired by pulverized coal, oil, or gas, or any combination of these fuels. Furnace bottom may be as shown or of hopper type.

fuel sources is no bar to enjoying VU advantages, for virtually all fuels and methods of firing can be used. The VU is supplied for burning pulverized coal, oil, or gas – or any combination of these fuels. It may be had with every basic type of stoker – spreader, underfeed, or travelling grate. Bagasse, and other waste products, can also be utilized.

Yes, VU versatility has brought public utility performance to many diverse industries throughout the United States and abroad. It can bring it to your plant too – with marked economies in operation. B-214

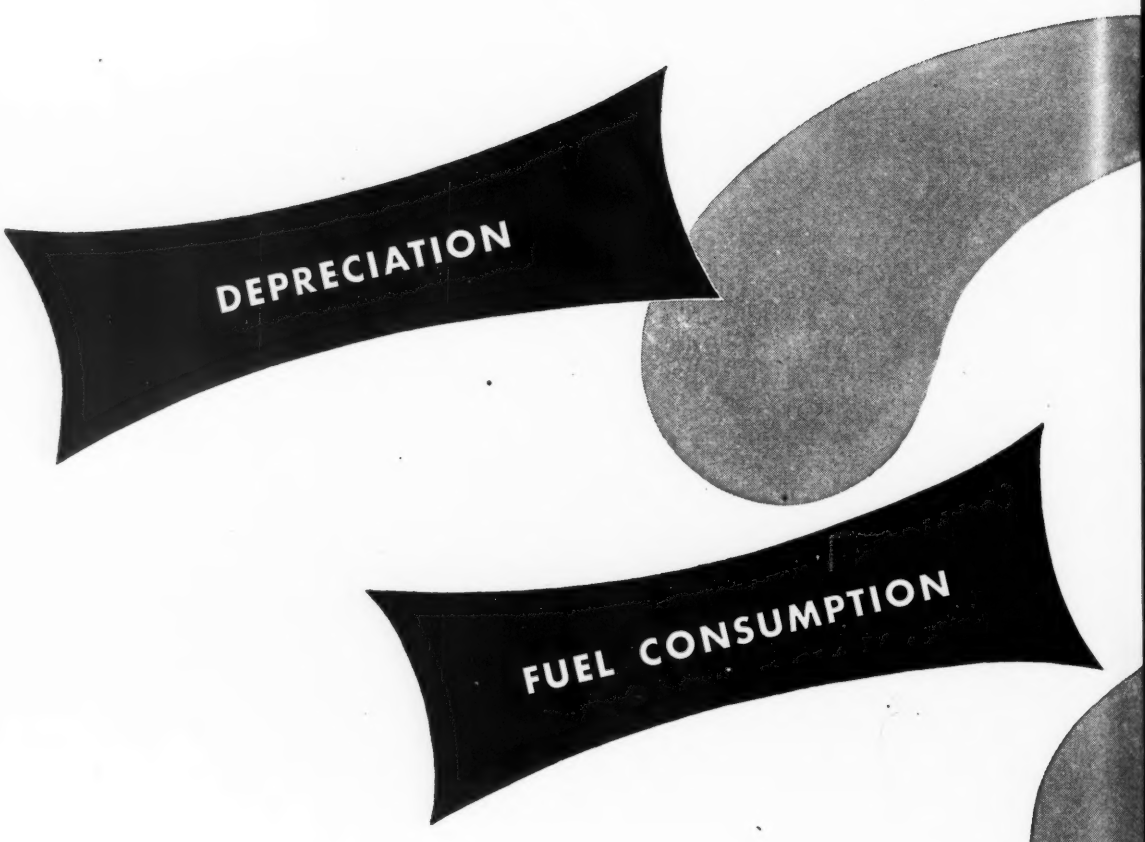


VU equipped with a C-E Spreader Stoker. Furnace proportions and water walls may be adapted to firing by any type of mechanical stoker.

C-E

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.



Consider the figures

When you buy a combustion control system, only the first cost is in the bid—and you have to look *beyond* first cost to know which system is your "best buy."

Let's take the matter of depreciation, for example. Not depreciation as an arbitrary figure for the convenience of the accounting department, but as a measure of the useful and efficient life of the equipment. The ruggedly built components of the Hagan system last as long as the boiler—and longer.

How much will maintenance cost you? Surprisingly little—with Hagan. Simplicity of design is a major factor here, and Hagan equipment is designed to give minimum opportunity for wear, to use the fewest possible parts which may get out of order, to make maintenance easy. As one old-timer put it: "You don't have to be no watchmaker to work on Hagan controls."

that aren't in the bid——

All of these figures on costs, however, are far less important than figures on fuel. Take for example a 100,000 lb./hr. boiler, running 24 hours a day, 300 days a year. Coal consumption will be roughly 5 tons an hour. At $6.00 a ton, your fuel bill will be $720.00 a day, $216,000 a year. Such a boiler will consume a million dollars worth of fuel in less than five years—and five years is only a fraction of the useful life of boiler and control.

Figures like this make it clear that the really important thing is not the cost of the control system, but what that system will do to your fuel costs—and that brings you right back to Hagan.

Hagan equipment lasts as long as the boiler, stays accurate, and gives you dependable, trouble-free service as long as it lasts.

Our engineers are at your service.

Hagan Corporation, Hagan Bldg., Pittsburgh 30, Pa.

HAGAN CORPORATION

HAGAN
HALL
BUROMIN
CALGON

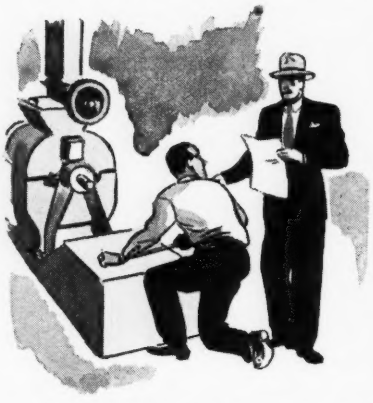
BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

Looking for Motors? Maybe We Can Help You!

ALLIS-CHALMERS AUTHORIZED DEALER

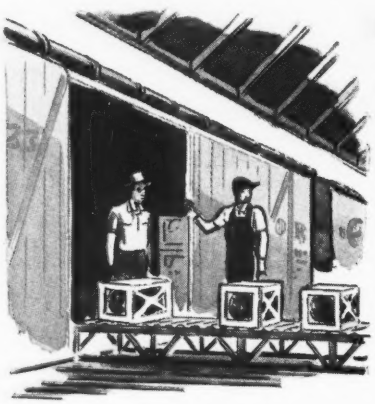
ALLIS-CHALMERS REPRESENTATIVE

Do You Need General-Purpose, squirrel-cage motors from 1 to 200 hp? Get in touch with your nearby Allis-Chalmers *Authorized Dealer* or District Office. Either may be able to help you from stock right now!



But For Really Big Motors — 250 to 25,000 hp and over — call your Allis-Chalmers *field engineer.* He's an *expert* on motors—can help you solve difficult drive problems, involving large or small motors, in the most economical manner.

Want Reliable Information on motor delivery? Call *either* your Allis-Chalmers dealer or district office. They have *up-to-the-minute* delivery information available to them!

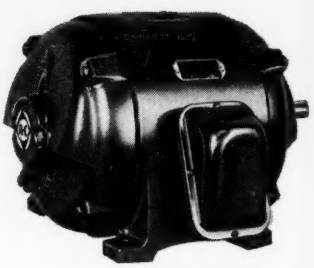


The Delivery Picture's getting brighter! Our motor-building capacity has been greatly increased. We've put new methods, new equipment to work to turn out *more* motors for industry, faster!

Motor "Headquarters"—½ to 25,000 hp and Up!

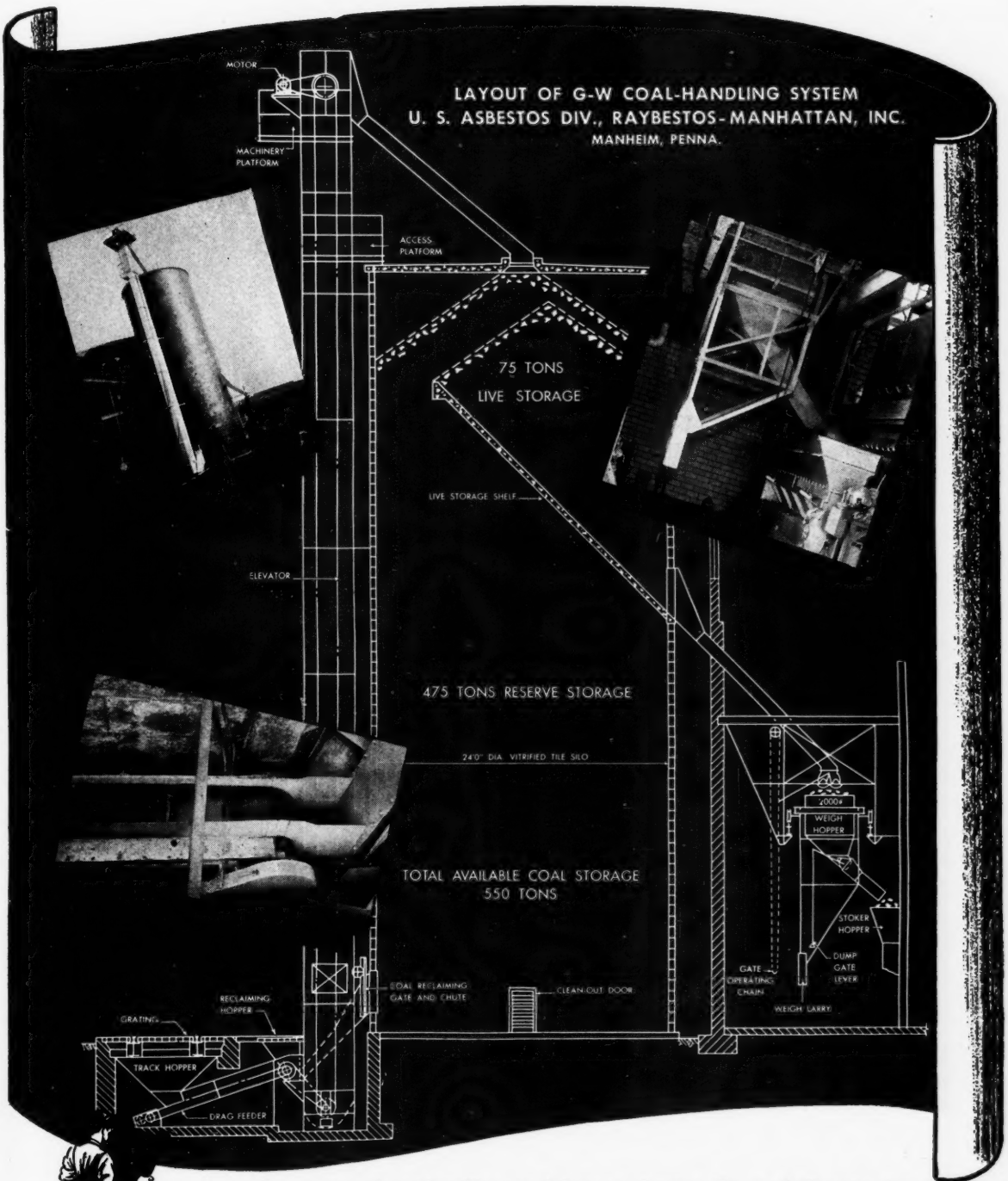
YOU SELECT from a *wide range* of motors when you call on Allis-Chalmers. And you can count on *expert* motor advice, too! The best possible motor selection is the result of careful appraisal of drive characteristics, the driven equipment, power source and surroundings. The best motor may not always be the first that meets the requirements.

Allis-Chalmers authorized motor dealers or factory representatives can help you choose wisely. They can save you time and money. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2401



ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products



A complete system of coal-handling: track hopper, elevator, silo—and all connecting equipment for mechanically transporting coal through the system to the stoker hoppers—all G-W. Basically simple . . . *your* conveyor can be apron, reciprocating or drag feeder; elevator—gravity or centrifugal discharge; silo—concrete, tile or steel; stoker served by spout, screw conveyor or weigh larry.

G-W will assume full responsibility for initial design, manufacture and complete erection.

G-W HANDLES IT . . .
faster • easier • cheaper

SINCE 1814

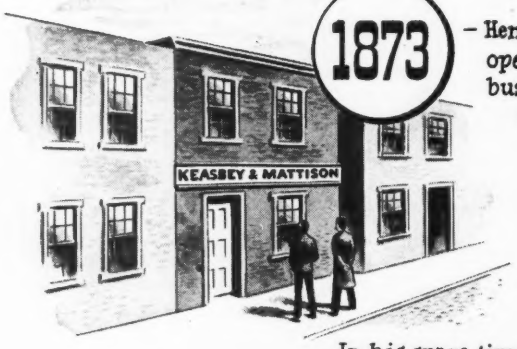
GIFFORD-WOOD CO.

3638

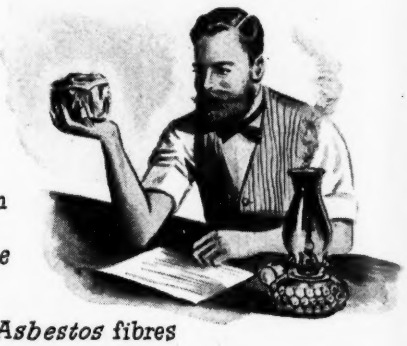
NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

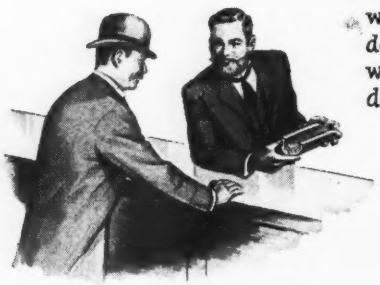
CHICAGO 6
565 W. WASHINGTON ST.



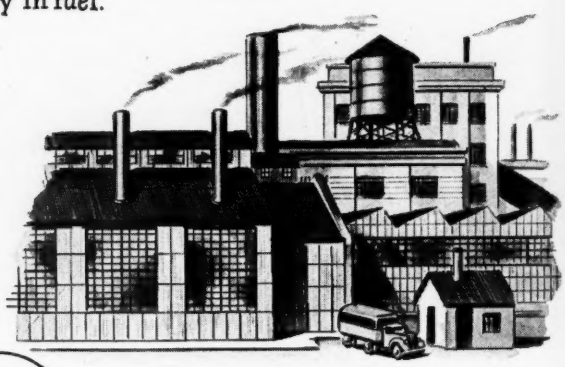
1873 – Henry G. Keasbey and Richard V. Mattison open a modest drug manufacturing business in Philadelphia. Basic ingredient: Magnesium Carbonate.



In his spare time, Dr. Mattison experiments with a fire-defying fibre called *Asbestos*... seeking ways to use it for the benefit of humanity.



1886-reward! By blending *Asbestos* fibres with basic Magnesium Carbonate, he develops 85% Magnesia Pipe Insulation which today saves Industry millions of dollars annually in fuel.



Further K&M research soon yields America's first *Asbestos* textiles in commercial quantities, America's first *Asbestos*-cement roofing shingles, and the first *Asbestos* Corrugated Sheets.

1948 – what started as a small drug business is today a leading factor in America's giant and strategic *Asbestos* Industry!

This year marks the 75th anniversary of the founding of Keasbey & Mattison Company—the pharmaceutical firm that branched out into one of America's primary producers of Asbestos and Magnesia products.

Today, K&M "Featherweight" 85% Magnesia insulation is still one of the Company's basic products. But in addition, K&M also makes a complete line of asbestos-cement materials including shingles, pipe for water mains, corrugated and flat lumber, sheet packings, paper and millboard, textiles.

In celebration of the anniversary, K&M has prepared a brief, interesting history of the Company. We will be glad to send you a copy with our compliments.

DIAMOND ANNIVERSARY 1873 K&M 1948 KEASBEY & MATTISON CO.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

"HAS OPERATED 99% OF THE TIME SINCE 1939"

reports the City of St. Mary's, Ohio, of their first 2500 K W Worthington Turbine Generator.

New 2500 KW Worthington Turbine Generator recently installed in municipal power plant of the City of St. Mary's, Ohio.

Mr. George Probst
Worthington Pump and Machinery Corporation
Steam Turbine Division
Wellsville, New York

Dear Mr. Probst:

You will be interested, I'm sure, to learn that our new 2500 KW Worthington Turbine Generator has been running continuously since it was put on the line about six months ago.

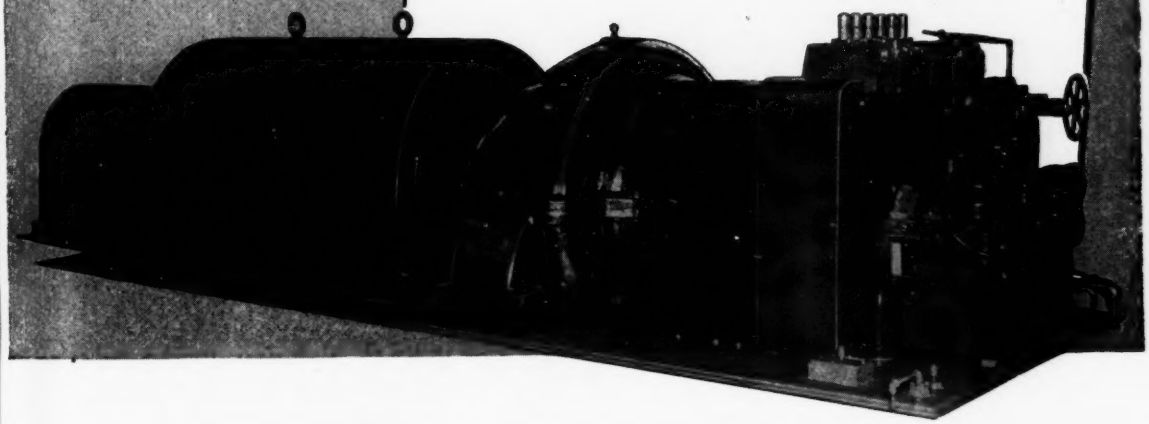
It's been eight years now since our original 2500 KW Worthington unit was started and it has operated 99% of the time ever since. On a number of occasions, it has carried loads of 3000 to 3500 KW for periods of three to four hours. We run both units a large portion of the time and they parallel very nicely.

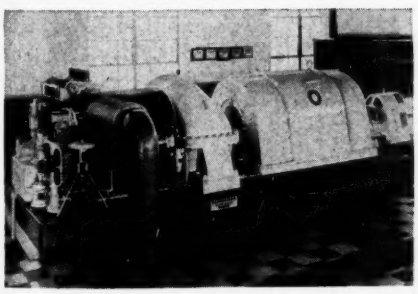
In fact, we do so well with these Worthington units that we would be glad to show them in operation to any of your prospective customers who care to visit our plant.

Very truly yours,
CITY OF ST. MARY'S

J M Hageman

City Engineer and Director
of Service and Safety





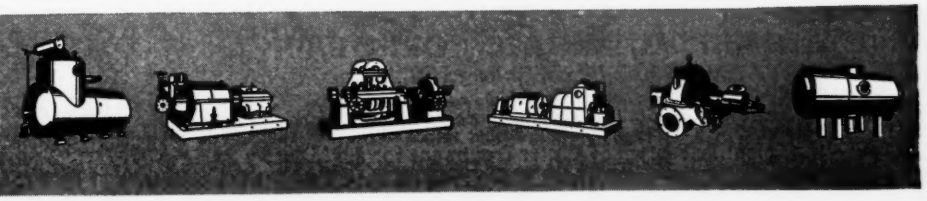
2500 KW Worthington unit installed in 1939. Turbine, straight, condensing type, operates on 400 lbs. steam pressure, 750 degrees total temperature and exhausts into a vacuum of 28"

Many similar reports from power users throughout the country testify to the trouble-free, cost-saving performance of Worthington steam turbine equipment. In your own turbine problems, Worthington specialists are always available for expert technical advice. And for further proof that *there's more worth in Worthington*, write for fact-full literature. *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N Y.*

WORTHINGTON

T7-1

A GREAT TEAM IN STEAM



HOW THE *Textile Industry Testifies*
TO PERMANENT RESULTS FROM THE
Nalco System of Water Treatment

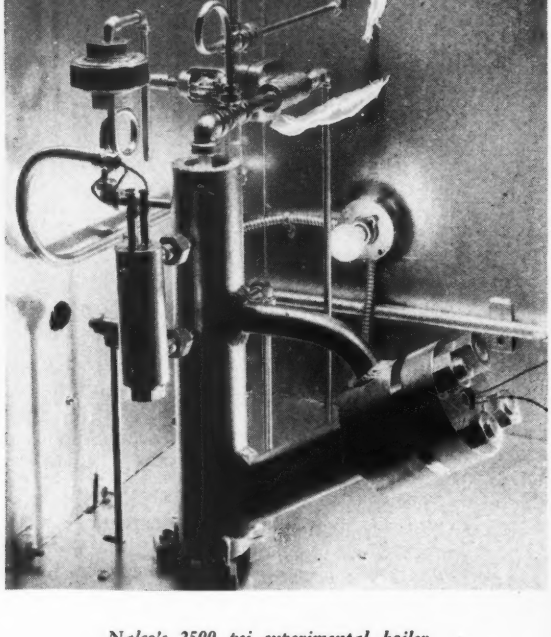
It is the continuously successful treatment of water, year after year, regardless of changing conditions or needs, that pays dividends to our customers. That is what the Nalco System offers. Nalco customers testify to this by their continued use of Nalco service and Nalco chemicals. For example, in the Textile Industry:

44% of all Nalco clients have been using the Nalco System for over 5 years,

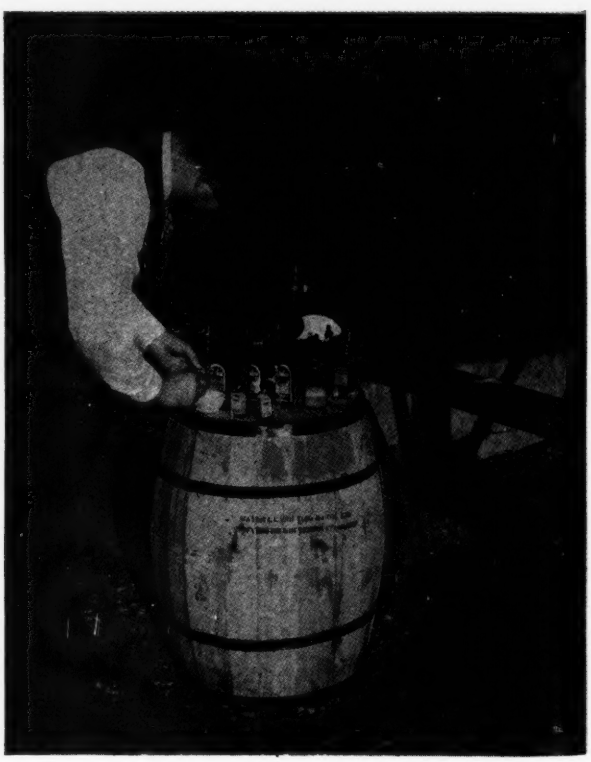
25% of the above group have enjoyed over 10 years of trouble-free water treatment;

50% of those benefiting from the Nalco System for over 10 years have been doing so for more than 15 years.

For a *permanent* solution to your water treatment requirements, turn to Nalco. Complete information on request.



Nalco's 2500 psi experimental boiler. Nalco boiler feedwater treatments are tried and proven here, not in your plant.



On-the-spot field service. Nalco field engineers are practical chemists who help to maintain continuously successful water treatment results.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place, Chicago 38, Illinois
Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto 8, Ontario

—the Scientific System of Water Treatment for All Industry

Nalco

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

BOILERS, ACCESSORIES

1 **Steam Generators, Packaged Type**—Bulletin gives dimensional drawings of 2 series offered. AG series is available in 250 psi working press. AGH series in 850 psi. Capacities range, respectively, from 3,000 lb per hr to 21,000, and 1,500 to 4,500 lb per hr. Explanation is included in this 4 page folder of the design, efficiency, superheat, controls, stacks, and foundations. Foster Wheeler Corporation.

2 **Operation and Care of Power Boilers**—Illustrated with color to show proper combustion with this type of boiler. Text explains, in order, rules to remember, construction of the boiler, identification stampings, how to wash a boiler, putting the boiler in service, handling the boiler in service, hand firing, care of grates in service, what to do when boiler is out of service, and all the various phases to consider with each stage. Kewanee Boiler Corporation.

3 **Avoiding Boiler Troubles**—Bulletin No. 33, 12 pages, consists of data sheets on: colloids, scale and how to remove it, corrosion and its elimination, after-treatment, and explanation of how this firm's product affects these different but related troubles. American K. A. T. Corporation.

4 **Smoke, and How to Prevent It**—This book of 16 pages contains no advertising matter. It is completely a self-help book to acquaint the reader with all the facts on smoke. It explains: causes, cost, and prevention of smoke, on hand, stoker, oil, and gas fired installations in all types of plants. Included is a 4 page folder showing the application of the equipment of this company to prevent smoke. Perfex Corporation.

5 **Draft Gauges**—Portable and stationary draft gauges are described in this 2 page Bulletin No. 205. Photographs illustrate the various models. They are declared to be accurate for the measurement of draft, air velocity and slight pressure fluctuations. They are shown with their furnished metal panel. The various gauges are fully described. F. W. Dwyer Mfg. Co.

6 **Air-Diffusers**—In this excellent Bulletin K-20, 32 pages, is described a line of adjustable air diffusers. Included is information on air direction and volume control, many photographs of the units, together with line drawings and a description of the diffuser. The engineering data includes selection and performance information and performance charts, selection and location information, dimensional tables and a description of the standard specifications for diffusers and accessories, assembly and erection, testing and balancing and air direction adjustment and air volume adjustment. W. B. Conner Engineering Corp.

7 **Single Retort Underfeed Stokers**—Four page folder, 3 ring punched, this bulletin has dimension drawings and capacity tables for 7 different sizes. The drawings are front, side and rear views of this stoker which has a grate area of from 5 to 8 sq ft per foot of length. Erie City Iron Works.

8 **Tube Cleaners**—This line of tube cleaners for use in refineries, power plants and chemical process plants is described in 48-page Catalog No. 76. Almost all types of cutter-head are described, as well as brushes and air, steam, and water driven motors. Electrically driven tube cleaning equipment and all accessories are described and illustrated. All descriptions of items include application data as well as technical information, operating hints and size tables. Bulletin closes with complete listing of company tube cleaner sizes. Thomas C. Wilson, Inc.

9 **Tube Cleaners**—This complete new line of tube cleaners is described and illustrated in 4 page Bulletin R-105 10M. Also shown are various types and sizes of motors for operation with water, compressed air and steam. Parts and accessories illustrated, include various types of heads, air valves for one-man operation, lubricators, and hose. Tables list sizes and types of tubes, and specify the tube cleaner recommended for each. Elliott Co., Roto Div.

10 **Small Oil Burners**—Featuring the new head designed for these units of this firm this four page folder explains how the new head will save oil. It tells how the burner heads may be changed if the capacity required should vary. Burners are in 0.75 to 7.0 gph capacity range. Richfield Manufacturing Corp'n.

11 **Wide Range Mechanical Oil Atomizer**—Seven pages of literature including a drawing to scale that shows all the features of atomizer. Equipment is offered in five sizes to accommodate small and large steam units. An explanation of operating methods is given that is worth while. Possible remote or automatic control is discussed. The Engineer Company.

12 **Constant Differential Oil Burning System**—Completely diagrammed and charted, bulletin No. 109-A not only explains how the constant differential system operates but also illustrates, in cutaways, the atomizer itself with complete explanation of how extreme fluctuating loads are handled under positive regulation with full flame control. Peabody Engineering Corporation.

ELECTRICAL

13 **Power Recorders**—A 6 page bulletin on remote operating power recorder Type 1028B. Bulletin explains with schematic and dimension drawings how the recorder works. Installation information is included. Performance data and operation are given in the text. Kollsman Instrument Div., Square D Company.

14 **Transfer Coils**—A line of dual heat transfer coils and coil terminals is described in leaflet A54. The leaflet is replete with specification line drawings and tables. It is stated for what purpose the coils may be used and what metals are used in their makeup. It is also shown how to specify by size and part numbers when ordering. Parker Appliance Co.

15 **Terminal Blocks**—These feed-thru terminal blocks are described in Bulletin DS-115. It is shown how they can be used for sub-panel and chassis connections where a soldered connection is desired. Mounting dimensions are given together with a dimensional drawing and a price list, Curtis Development & Mfg. Co.

16 **Step Feeder Voltage Regulator**—Operating and construction features of this equipment in 2400, 4800, and 6900 v single phase ratings are given. How low excitation current, close control, and low overall maintenance are attained is illustrated with diagrams, cutaways, and application photos. Allis-Chalmers Mfg. Co.

VALVES, STRAINERS, DRAINERS

17 **Steel Valves**—This handy pocket Bulletin 700, 24 pages, outlines the more widely used steel valves and gives catalog references where full details and dimensions of each valve may be found. Shown are stop, screw stop, gage, straight-through, non-return, blow-off, gate, check, hydraulic ball check and hydraulic stop valves and others. Noted are ASA working pressure ratings for each group of valves, and the uses to which these valves may be put. Edward Valve and Mfg. Co.

18 **Butterfly Valves**—Catalog A, 60-pages, is an excellent engineering manual on this line of rubber seat butterfly valves. First discussed are the design principles, followed by an explanation of the valve applications. Many photographs illustrate text. Remainder of the catalog contains engineering drawings and illustrations of the various type valves, including those handwheel, chainwheel, motor, cylinder and plain stem or lever operated. A section deals with special condenser circulating water valves, while another part of the booklet is devoted to the pulverized fuel valve and floor stands for manual or electric motor operation. Henry Pratt Co.

19 **Valve Bulletin**—A line of balanced, pilot, butterfly, float and motor operated valves is described in this 16-page bulletin. Engineering data includes drawings of the various type valves, together with a description of their operation and applications. Complete dimensional tables and price lists are included. Davis Regulator Co.

20 **Pressure Reducing Valves, Streamlined**—The construction and operation as well as capacities of these valves is depicted with colored flow diagrams, cutaways, and capacity charts for obtaining the correct size and type. A. W. Cash Company.

21 **Expansion, Solenoid, Valves; Controls**—Catalog presenting equipment made for refrigeration and air conditioning by this firm. Illustrated with photos of equipment. Seven of 15 pages are given to capacity tables and a pressure-temperature chart. Operating and lifting pressure tables. How to select expansion valves. Detroit Lubricator Company.

22 **Pressure Reducing Valves**—Bulletin No. 477 explains and discusses this firm's pressure reducing valves of the self-contained type, master pressure controls, remote controls, and desuperheaters. Well illustrated with application photos and cutaways to show construction and operation. Tables present further data on the equipment. Northern Equipment Co.

23 **Multiport Drainers**—This 8 page bulletin illustrated with cutaway sections, application photos, and tables, ex-

---

APRIL, 1948

POWER GENERATION
53 W. Jackson Blvd.
Chicago 4, Ilinois

Please have the manufacturers send me without obligation the literature indicated by the number:

_____
_____
_____

Please Print Clearly

Your Name_____

Your Title_____

Your Company Name_____

Company Address_____

City_____ State_____

(If you prefer delivery at your home also fill in below)

Home Address_____

City_____ State_____

plains the operation and gives the capacities, dimensions, construction data, and list prices of the multiport drainers. Five in both standard and external cage drainers are available. Connections range from 1¼ in. to 6 in. Cochrane Corporation.

24 **Strainers**—For use on water, steam, oil, air or gas supply lines are described and illustrated in Folder No. 115. A picture story on the last page of the folder gives complete instructions for cleaning. Hays Mfg. Co.

INSTRUMENTS, CONTROLS

25 **Operation Recorders**—Bulletin No. 247, 16 pages, contains a factual description of the operation recorder, its design features, methods of installation and applications. Photographs illustrate the material. The types of records are explained and illustrated and the internal wiring is diagrammed. Drawings show how the recorders may be actuated by a great variety of physical and electrical phenomena. The selection of types is fully discussed. Esterline-Angus Co., Inc.

26 **Viscosimeter**—For measurement and control of viscosity in a moving stream under full line pressure from 0.0008 to 800,000 centipoises. These instruments are available in simple indicating form or arranged for continuously recording viscosity values on a 24 hr chart, or for controlling fluid viscosity by automatic blending or heating. Diagrams and charts show typical installations, construction features, capacities and dimensions of the unit. Bulletin No. 88. Fischer & Porter Co.

27 **Concentration Measurements**—Rapid test, control and preparation of industrial solutions such as sodium hydroxide, alkali, water, brines and condensates by means of the Solu-Bridge electrolyte conductivity bridge is covered in this 4 page Bulletin RD-102. Prices and specifications of 12 different models ranging from $25 to $53 are included. Industrial Instruments, Inc.

28 **Conductivity Apparatus** — Bulletin RD-104, 4 pages, contains information on conductivity apparatus for boiler water and condensate. Photographs illustrate various models and conductivity cell types. Drawings are used to present a number of calibrated panels. A line drawing shows the details of a cell holder. Price lists are included. Method is given for selection of correct model. Industrial Instruments, Inc.

PUMPS

29 **Pumping Units**—Bulletin 726-C is a 12-page catalog which describes the company's line of "Unipumps". Photographs of the pumps are presented and cross-sectional wash drawings show the construction and operation of the units. Two full page selection tables are included. Another full page of engineering information includes dimensional data on pump and motors; tables are supplemented by dimensioned line drawings. An unusually useful section tells "How to Reduce Pump Costs." This is accompanied by a full page friction table showing friction of water in pipes for various heads. Typical installations are pictured. Weinman Pump Mfg. Co.

30 **Turbine and Centrifugal Pumps** — Bulletin of 12 pages explaining with diagrams, cutaway sections, tables, and text the condensate, deep well, mixed flow, centrifugal, and turbine pumps made by this firm for industrial use. Aurora Pump Co.

TURBINES

31 **Mechanical Drive Steam Turbines**—Illustrated with: line drawings, dimensions drawings; close-ups of controls, nozzles, wheel, governor, and governor throttling valve. Photos of the complete unit are shown. Whiton Machine Company.

PIPING, FITTINGS

32 **Allowable Working Pressures Handbook**—For the use of fabricators and users of industrial piping systems this book gives the allowable working pressure for welding fittings in 5 classes of piping. Tables are based on ASME Construction Code, 1946, and American Standard Code for Pressure Piping. Covered are plant process, hydraulic machinery, district heating, and refinery, piping. Tube Turns, Inc.

33 **Fittings**—This is an order sheet for copper line fittings, sizes available in various types with prices are given as well as directions on how to order. All fittings are pictured and described. Kerotest Manufacturing Company.

MATERIALS HANDLING

34 **Vibrating Screens**—A 4 page bulletin describing the vibrating screens made by this firm for sizing or separating any kind of material. Explained are the bearings, circle throw, adjustable stroke, angle adjustment, construction, mounting, and screen cloth. Many various sizes listed. Hewitt-Robins Incorporated.

35 **Magnetic Pulley**—Bulletin 260-A, contains engineering data on a line of magnetic pulleys. It tells how to select the proper magnetic pulley, represents by means of a graph the advantage that can be derived from using the company's pulley, and shows photographs of typical installations. Also included is a full page dimensional, capacity and weight table, and a drawing to illustrate the material. Dings Magnetic Seperator Co.

36 **Level Indicator**—The outstanding features and the positive action of a level indicator for bins, chutes, hoppers, silos or any material storage is described and illustrated in this 4 page bulletin. It is shown how the level indicator can be connected to any standard light, bell, horn or any type electrical signal. McCathron Boiler Works Co.

TREATMENTS

37 **Substitute for Soda Ash in Feed Water Treatment**—This is a technical paper offered to help operators during the soda ash shortage. It discusses various methods that may be employed to secure properly treated feedwater using little or no soda ash. Practical and useful. W. H. & L. D. Betz.

38 **Bromox Water Treatment**—Six pages of explanation about this method of treating water to eliminate the undesirable effects resulting from the chemical treatment of water. This is reputed to free the water from factors causing irritation, objectionable tastes, and odors, while controlling the pH or ionization of the water. Sterne & Maloy Company.

39 **Rapid Reactors for Water Conditioning**—This 12 page bulletin, No. 4425, contains detailed explanations of the process and operation of these rapid reactors. Color scheme and line drawings depict the action and component parts of the equipment, which covers the ranges from 0 to 100 gpm, 100 to 500 gpm, and from 500 to 3000 gpm. Cochrane Corp.

40 **Electronic Processing of Water**—This folder of 28 pages fully describes the purposes, functions and uses of this electromatic electronaire. It shows why there is a necessity for use of this device, what it is, how it functions, what it does, how it is used, and what its capacities are. Prices are listed. Instructions for the installation of the various models complete the folder. Ample drawings and photographs illustrate the material. Electromatic Engineering Co.

41 **Soot Remover, Fuel Oil Treatment**—Two bulletins, issued recently, cover fuel oil treatment and procedure and soot removal. An explanation of what takes place when sludge forms is presented and the difference between treated and untreated tanks is explained by description and drawings. Method of use of the compound is given. The bulletin on soot removal shows the difference in boiler tubes when treated and untreated and gives information on loss of efficiency due to soot formation. Alladdin Laboratories, Inc.

MAINTENANCE

42 **Steel Scaffolding**—Included with this 2-page folder, describing a line of sectional steel scaffolding made of welded tubular steel, are many sketches of sections that can be applied to any problem the engineer may have. The bulletin, itself, includes typical installation photographs and a discussion of the applicability of the scaffolding. Universal Fittings & Scaffolding Co.

43 **Metallizing Gun**—A metallizing gun for manual spraying of all metals is described in this 4-page Bulletin 50. Photographs indicate typical applications of the gun. Representative spraying speeds for coating with various metals are listed. Metallizing Engineering Co., Inc.

44 **Pipe-Stud Extractors** — Illustrated and described in this 4-page bulletin is a master set of pipe and stud extractors. Photographs and text show how they work and what they do. The complete range of sizes is indicated in another photograph. The case of extractors together with the selector plate on the inside of the cover of the box is shown to help the mechanic to tell at a glance what size extractor is required for the broken pipe. Reps Tool Co., Inc.

45 **Nut-Setter**—An electric torqueless impact nut-setter is described in this 4-page bulletin. Photographs show how it can be used for automotive repair work, for maintenance operations, for machine tool assembly and for many other uses. Complete specifications are given. Illinois Gage & Mfg. Corp.

46 **Concrete Floor Repairs**—This 4 page leaflet explains the application and characteristics of this product for patching floors. Smooth-On Mfg. Co.

47 **Coating's Handbook**—This new handbook, 31 pages, describes how this company handles the problems of condensation drip and pipe preservation. It tells what their insulation type coating does, how it can be used, methods of application, and what users say about the product. It includes many charts and graphs to show the need for and the effect that this coating has upon applied surface. Innumerable photographs are used to illustrate its contents. J. W. Mortell Co.

48 **Gasketing**—Included in this 6-page handbook is information on a line of flexible, oil resistant and corrosion resistant gasketing. Photographs show the various types of materials: sheet, extruded channel, tape and tubing and a table lists the various sizes of these several kinds of gasketing. U. S. Stoneware.

49 **Welding Problems**—The causes and cures for hot-running welding cables and connections are effectively explained in this 2-page Bulletin No. CC-47. Men charged with operating and maintaining welding cables will find many helpful hints in this practical article. Tweco Products Co.

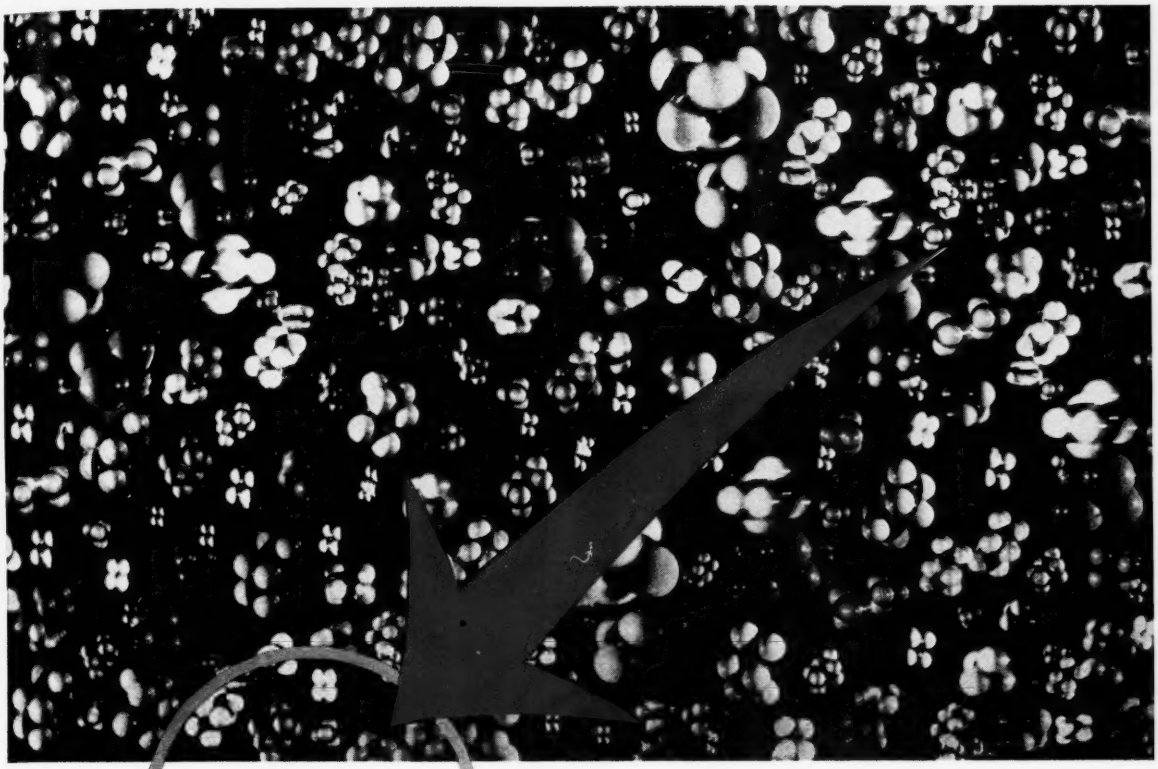
MISCELLANEOUS

50 **Oiling Devices**—Bulletin No 15 lists the oiling devices made by this company for use with engines, pumps, compressors, presses. These are suitable for application to moving as well as stationary parts. Telescopic tube sets are listed as well as repair parts for oiling equipment. Dimensional drawings of all parts and devices are given as are photos of actual equipment. Wm. W. Nugent & Co., Inc., Mfgrs.

51 **Overhead Crane Control**—Consisting of a simple rotor and a stationary field member, this unit, known as the Magnetorque, exerts all braking forces electromagnetically. Since there are no rotating parts, no friction, no metal-to-metal contact, adjustments, etc., there is nothing to wear out. Seven charts give speed-load curves, magnetic, and breaking characteristics of the unit. Typical applications and advantages are included in this 6-page Bulletin No. C-39. Harnischfeger Corp.

52 **Moulded Fabric Bearings**—Bulletin HB-542, 4 pages, describes performance qualities produced by special methods of moulding resin-bonded fabrics to the finished shape and size. A chart shows the comparative performance of moulded and machined surfaces, while photographs illustrate these two surfaces. Drawings are also used to illustrate this point: one showing comparative installation clearances, another the effect of heavy impact or shock loads, another the effect of misalignment, while a fourth shows the effect of shifting pressures. Gatke Corp.

53 **Steam Jet Heaters**—This 20 page catalog contains a line of steam jet heaters for liquids. Photographs and text describe the various heaters and sparger nozzles, together with general information on their construction and operation. Tables and drawings give complete data on dimensions, connection sizes, weights of the various types and piping arrangements. Typical applications are diagrammed. Schutte and Koerting Co.



Less than one in 250,000

Fluor Glycol-Amine Gas Treating Process reduces Hydrogen Sulphide in natural gas to less than 1 molecule in 250,000

The Fluor Glycol-Amine Process is capable of producing gas containing less than 0.25 grains of H_2S per 100 SCF, or less than one part in 250,000.

This "tremendous trifle" often means the difference between meeting or not meeting the most stringent gas purity requirements. It often decides whether the final result is sour gas or sweet profit, for gas thus treated is *guaranteed* to meet the Bureau of Standards Lead Acetate Test.

In addition, simultaneous dehydration of the gas stream is effected... thus eliminating the need for further drying after the treating operation.

Fluor invites owners and operators of gas-producing properties to submit their gas-treating problems. Fluor has much more than a patented process...it has the organization, the know-how and the show-how that counts in the finals...in following through with the design and construction of the completed plant.

FLUOR

Glycol-Amine GAS TREATING PROCESS

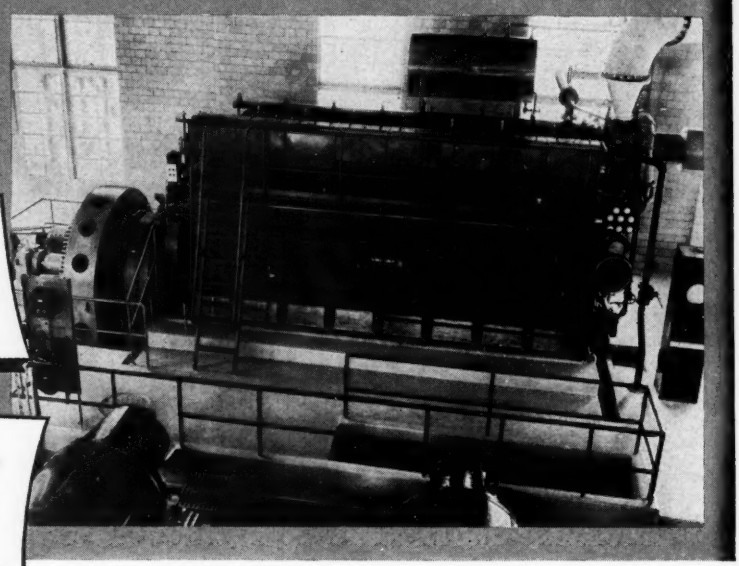
PRODUCTS *Cooling Equipment, Mufflers, Gas Cleaners, Pulsation Dampeners*

SERVICES *Designers and Constructors of Refinery, Chemical and Natural Gas Processing Units*

THE FLUOR CORPORATION, LTD., *Los Angeles 22* · NEW YORK · PITTSBURGH · KANSAS CITY · HOUSTON · TULSA · BOSTON

OVER 36% Thermal Efficiency!*

In the FIRST Supercharged Dual Fuel Diesel to Demonstrate All Its Guarantees



* Developed by this Worthington Supercharged Dual Fuel Diesel Engine, Type SEHGO-8, on acceptance test at the municipal plant, Lamar, Colorado.

* TEST DETAILS: 7050 net Btu per brake horsepower-hour at full load . . . total gas and pilot oil fuels included . . . elevation 3600 ft.

First in the U. S. to produce a 4-cycle Dual Fuel Diesel . . . first in the world to supercharge this type of engine . . . Worthington offers the Lamar data as proof of *thinking ahead* in Diesel engineering. But such records are only part of the Worthington economy story. Today, with a scarcity of all fuels in prospect, you can save by

USING THE CHEAPEST FUEL AVAILABLE

Worthington Diesels, naturally aspirated or turbo-charged, are built in three fuel-burning types — Oil, Gas or Dual Fuel. With Worthington Dual Fuel Diesels you can burn oil and gas in any ratio, or switch to either completely — and instantly — permitting lowest fuel costs under changing conditons.

CHOOSE FROM THE WORLD'S LARGEST LINE

Besides the widest range of Diesel and gas engine types and sizes, Worthington brings a wealth of experience in design, construction, and application to provide you with maximum power at lowest cost. For further details that prove *there's more worth in Worthington*, contact *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

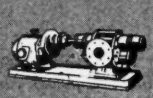
WORTHINGTON

YOUR PARTNER IN POWER PROGRESS

Diesel engines, 150 to 2,640 hp . . . gas engines, 175 to 2,470 hp . . . dual fuel engines, 225 to 2,470 hp.

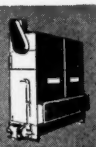
WORTHINGTON-BUILT AUXILIARIES

Air King Compressors

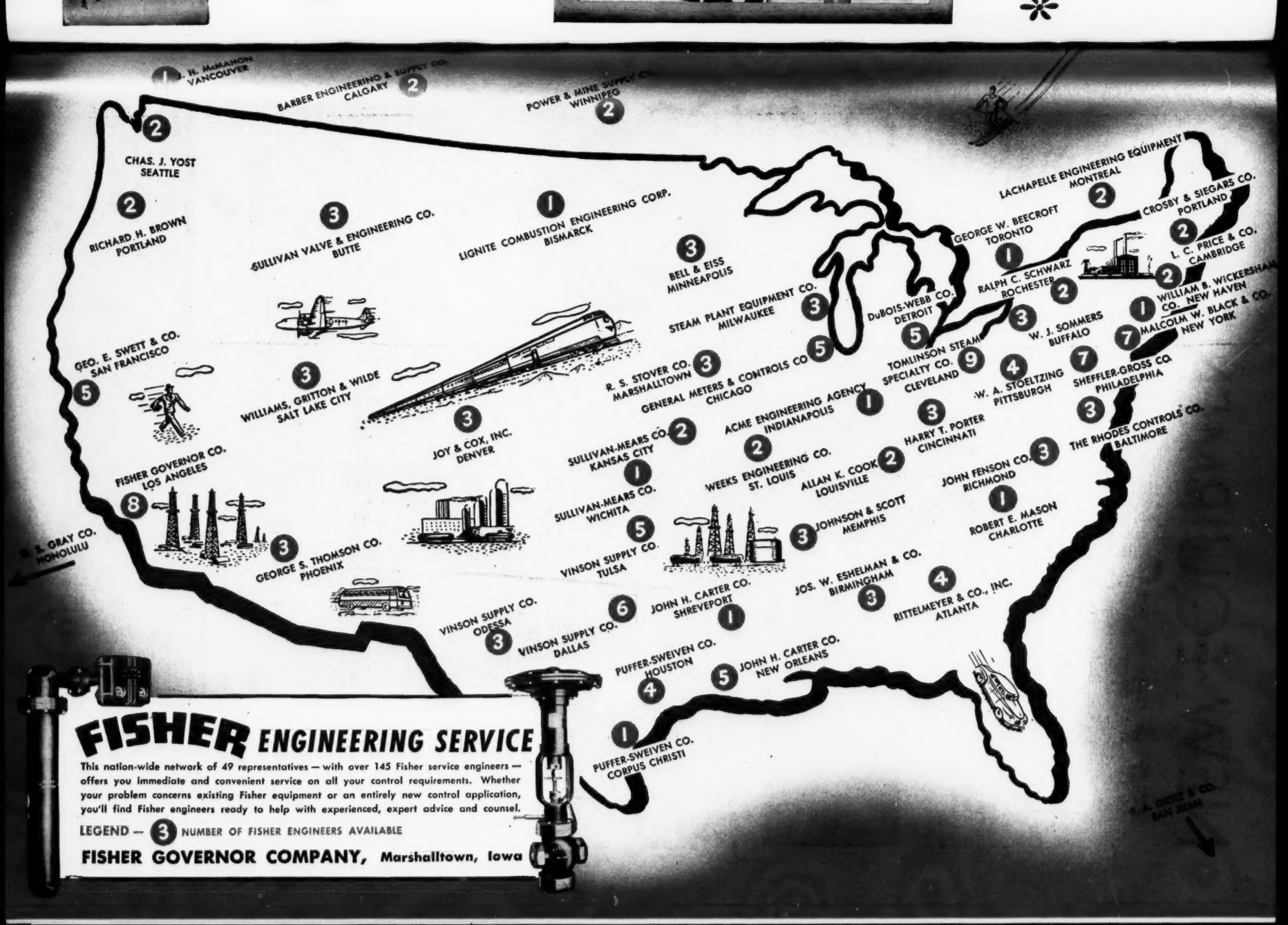


Oil Transfer Pumps

Cooling Water Circulating Pumps



Evaporative Type Engine Water Cooler


J. H. McMAHON VANCOUVER 1
BARBER ENGINEERING & SUPPLY CO. CALGARY 2
POWER & MINE SUPPLY CO. WINNIPEG 2
CHAS. J. YOST SEATTLE 2
RICHARD H. BROWN PORTLAND 2
SULLIVAN VALVE & ENGINEERING CO. BUTTE 3
LIGNITE COMBUSTION ENGINEERING CORP. BISMARCK 1
BELL & EISS MINNEAPOLIS 3
STEAM PLANT EQUIPMENT CO. MILWAUKEE 3
DuBOIS-WEBB CO. DETROIT 5
LACHAPELLE ENGINEERING EQUIPMENT MONTREAL 2
GEORGE W. BEECROFT TORONTO 1
CROSBY & SIEGARS CO. PORTLAND 2
L. C. PRICE & CO. CAMBRIDGE 2
RALPH C. SCHWARZ ROCHESTER 2
WILLIAM B. WICKERSHAM CO. NEW HAVEN 1
MALCOLM W. BLACK & CO. NEW YORK 7
W. J. SOMMERS BUFFALO 3
TOMLINSON STEAM SPECIALTY CO. CLEVELAND 9
W. A. STOELTZING PITTSBURGH 4
SHEFFLER-GROSS CO. PHILADELPHIA 7
THE RHODES CONTROLS CO. BALTIMORE 3
GEO. E. SWETT & CO. SAN FRANCISCO 5
WILLIAMS, GRITTON & WILDE SALT LAKE CITY 3
R. S. STOVER CO. MARSHALLTOWN 3
GENERAL METERS & CONTROLS CO. CHICAGO 5
JOY & COX, INC. DENVER 3
SULLIVAN-MEARS CO. KANSAS CITY 2
ACME ENGINEERING AGENCY INDIANAPOLIS 1
FISHER GOVERNOR CO. LOS ANGELES 8
SULLIVAN-MEARS CO. WICHITA 1
WEEKS ENGINEERING CO. ST. LOUIS 2
ALLAN K. COOK LOUISVILLE 2
HARRY T. PORTER CINCINNATI 3
JOHN FENSON CO. RICHMOND 3
ROBERT E. MASON CHARLOTTE 1
VINSON SUPPLY CO. TULSA 5
JOHNSON & SCOTT MEMPHIS 3
GEORGE S. THOMSON CO. PHOENIX 3
R. S. GRAY CO. HONOLULU
VINSON SUPPLY CO. ODESSA 3
VINSON SUPPLY CO. DALLAS 6
JOHN H. CARTER CO. SHREVEPORT 1
JOS. W. ESHELMAN & CO. BIRMINGHAM 3
RITTELMEYER & CO., INC. ATLANTA 4
PUFFER-SWEIVEN CO. HOUSTON 4
JOHN H. CARTER CO. NEW ORLEANS 5
PUFFER-SWEIVEN CO. CORPUS CHRISTI 1
R. A. ORTIZ & CO. SAN JUAN

FISHER ENGINEERING SERVICE

This nation-wide network of 49 representatives — with over 145 Fisher service engineers — offers you immediate and convenient service on all your control requirements. Whether your problem concerns existing Fisher equipment or an entirely new control application, you'll find Fisher engineers ready to help with experienced, expert advice and counsel.

LEGEND — (3) NUMBER OF FISHER ENGINEERS AVAILABLE

FISHER GOVERNOR COMPANY, Marshalltown, Iowa

NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Generation, 53 West Jackson Boulevard, Chicago 4, Illinois

A

Car Unloader. An electric powered vibrating unit that unloads frozen coal from hopper cars in an average of less than ten minutes has been announced. The maker states that the Shakeout, requiring only one or two men to operate it can empty a 50 or 70 t car containing bulk materials in 2 to 5 min. The 5 t Shake-

out is placed astride the sides of the car by a hoist. In operation it sets up rhythmic harmonics within itself which are transmitted to the car by contact. Since no men are required to be in the car during this operation safety for the unloading crew is a feature. Hewitt-Robins Inc.

B

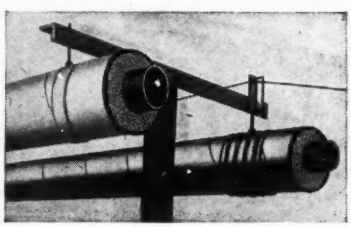
New Air Velocity Meter. An improved air velocity meter that will measure accurately velocities as low as five feet per minute, is announced. The new model incorporates the basic noble-metal thermopile principle, a larger, more accurate meter, and also includes an increase in the standard range of the instrument from 2000 to 6000 fpm. The lower half of the scale is expanded for accurate reading of velocities from 0 to 200 fpm. while the upper half is compressed logarithmically for readings up to 6000 fpm. The instrument may be operated directly from 110 v a-c outlet or from a portable battery operated power pack. The portable power pack is constructed in a metal carry-

ing case which includes room for the instrument and cable.

The thermopile is installed in a ½ in. dia. probe which may be plugged directly into the case, placed on an extension wand, or installed at a remote location. Hastings Instrument Co.

C

Pipe Units. An outstanding feature of these Foilclad pipe units for overhead distribution of oil, viscous fluids, process liquids and steam, is the fact that pipe in these units is insulated at the factory to meet individual project specifications. The units are shipped in 21 ft sections, completely

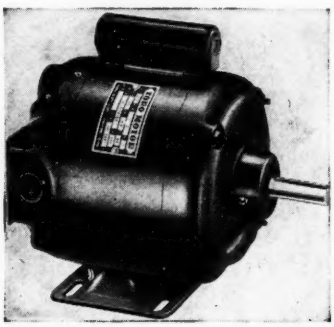


prefabricated and ready for installation with only one handling required at job site.

In the prefabrication of these units, asbestos, cork or other insulation, as specified, is machine coated with high temperature asphalt and tension wrapped with asphalt-saturated asbestos felt. A second coating of asphalt is followed by a tension wrapping of aluminum or copper foil which forms a perfect bond with the asphalt. Ric-wil Co.

D

New Fractional Motors. Triple seal windings, leaving high torque starting characteristics are a feature of the new line of type CSI capacitor start, fractional horsepower motors. The rotor is of all welded, pure copper bar construction. According to the



manufacturer, these engineering features provide for a low starting current combined with high starting torque. Motors are of splash proof design, with sturdy steel frames and die cast aluminum alloy end bells with cast-in terminal for easy wiring. Either solid or resilient bases are offered, slotted for easy belt adjustment. Frame ratings of 1/6, ¼, ⅓ and ½ hp, single phase, 60 cycle, 115-230 v can be supplied, with heavy duty precision sleeve bearings or ball bearings. These motors are particularly adaptable to such applications as conveyors, stokers, pumps, compressors, etc., where high starting torque, heavy loads and long service are required. Torq Electric Mfg. Corp.

E

Package Steam Generators. A new line of package steam generators up to and including 27,000 lb per hr range, has been announced. The units are assembled at the factory, including refractory and insulation, and are ready to generate steam when delivered and installed. Designs avail-

---

POWER GENERATION
53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation further information on the equipment indicated by the following letters:

.....
.....
.....
.....
.....

APRIL, 1948

Please Print Clearly

Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City..... State.....

(If you prefer delivery at your home also fill in below)

Home Address.....

City..... State.....

No worry about "weak links" when all piping is Crane

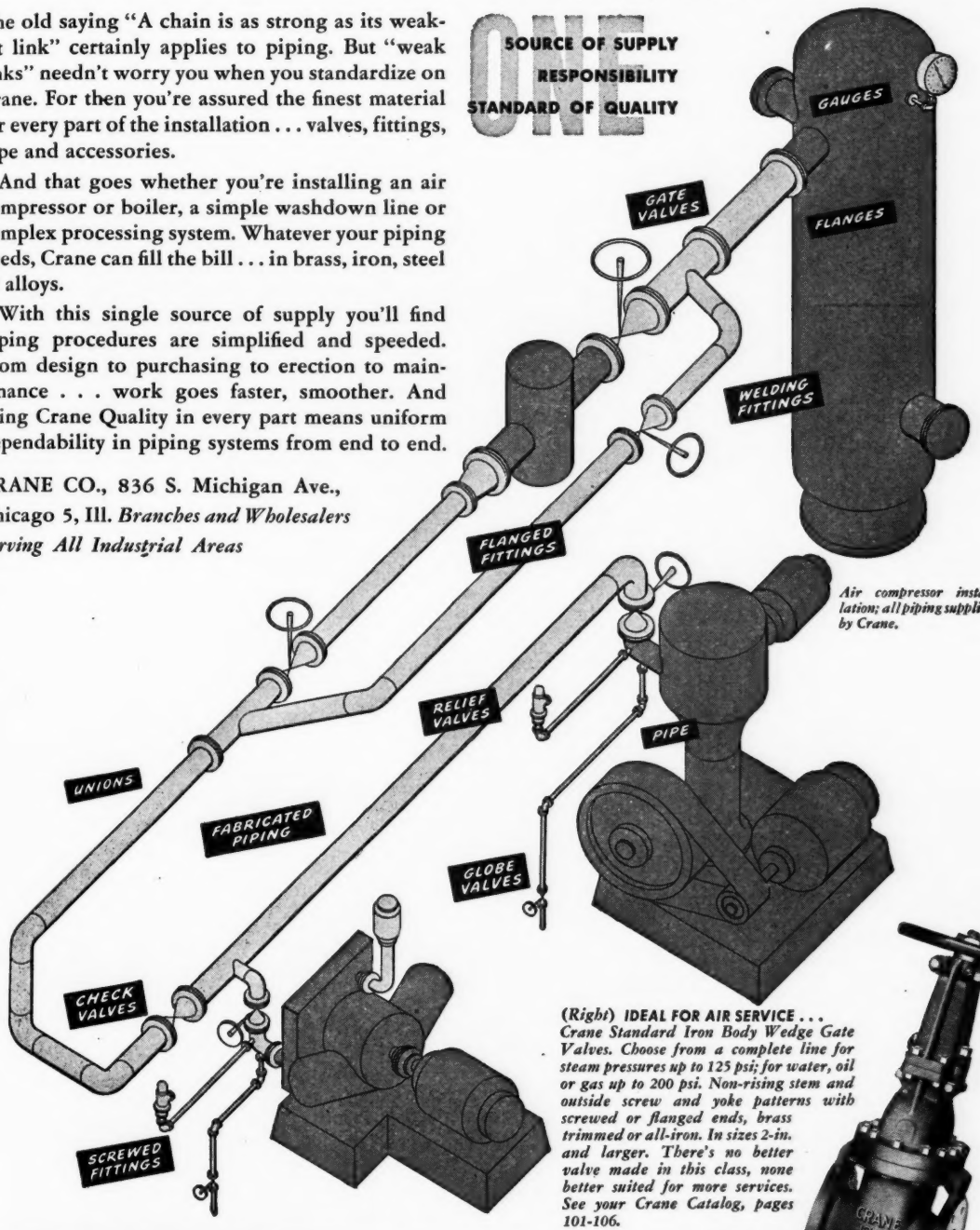
The old saying "A chain is as strong as its weakest link" certainly applies to piping. But "weak links" needn't worry you when you standardize on Crane. For then you're assured the finest material for every part of the installation . . . valves, fittings, pipe and accessories.

And that goes whether you're installing an air compressor or boiler, a simple washdown line or complex processing system. Whatever your piping needs, Crane can fill the bill . . . in brass, iron, steel or alloys.

With this single source of supply you'll find piping procedures are simplified and speeded. From design to purchasing to erection to maintenance . . . work goes faster, smoother. And using Crane Quality in every part means uniform dependability in piping systems from end to end.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas*

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Air compressor installation; all piping supplied by Crane.

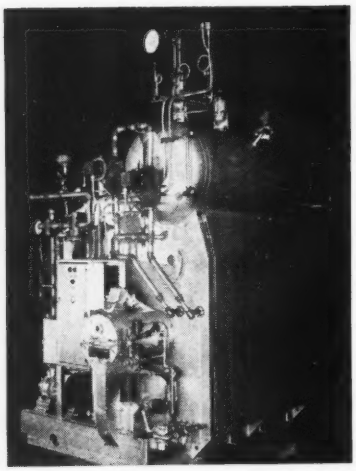
(*Right*) **IDEAL FOR AIR SERVICE . . .** *Crane Standard Iron Body Wedge Gate Valves. Choose from a complete line for steam pressures up to 125 psi; for water, oil or gas up to 200 psi. Non-rising stem and outside screw and yoke patterns with screwed or flanged ends, brass trimmed or all-iron. In sizes 2-in. and larger. There's no better valve made in this class, none better suited for more services. See your Crane Catalog, pages 101-106.*

EVERYTHING FROM . . .

VALVES . FITTINGS
PIPE . PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM



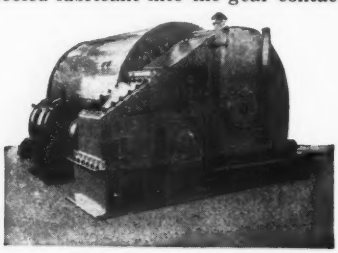
able provide for both oil and gas-firing, and a coal-fired unit will be ready shortly. Two series, low pressure (up to 250 lb) and high pressure (up to 850 lb), are being produced at present.

Basic engineering design provides for installation of superheaters either as original equipment or for later addition. Combustion controls provide full or semi-automatic operation, as desired, and are an integral part of the "package". Operation of the units from a central control panel is simple. Foster Wheeler Corp.

F

Ball Tube Mill. Outstanding among the many new features included in this new ball tube mill is the use of the spreader-feeder principle (for higher capacity per unit size and for handling extremely wet fuel without clogging up the mill). A 3-point suspension system on heavy duty, self-aligning type, double-row, anti-fraction roller bearings in automatically lubricated, sealed housing helps lower friction losses in starting and running and gives longer bearing life.

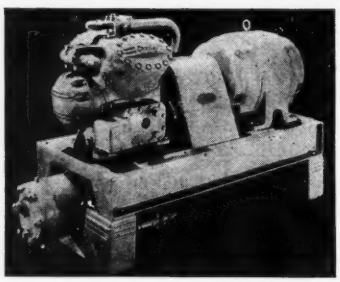
A general-purpose, normal-torque, standard-speed electric-drive motor in combination with automatic-clutch coupling equipment is used for shockless, smooth starting and efficient running with less expensive, standard motive-power equipment. The totally enclosed silent reduction gear mechanism, using all-steel long-life, reversible herringbone gears, which are supported in self-aligning type, heavy duty anti-friction roller bearings, with floating, self-centering shafts, is said to reduce drive power losses. An automatic-pressure lubrication system furnishing filtered and cooled lubricant into the gear contact



areas and to drive bearing before starting and driving operation helps reduce starting and running power losses and prevent early wear of equipment not lubricated before starting. Riley Stoker Corp.

G

Reciprocating Compressors. Ranging from 5 to 100 hp, the new machines for air conditioning or low temperature duties, operate at high speed. The compressors are so constructed that they can be assembled in more than 1,000 different combinations. All components; the compressor, the motor, the base, the coupling, and the condenser, can be individually selected to match the

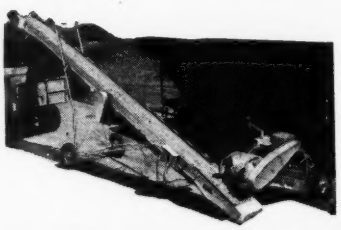


specific requirements of the job to be done. Unit can be assembled on the job. Users can select either a coupling for direct drive or a flywheel for V-belt drive. Features are automatic load-free starting, built-in automatic load levelers, external control of capacity, vapor-cushioned valves, removable cylinder sleeves so that both sleeves and pistons can be easily replaced, vapor cooled cylinders, removable precision bearings, oil-cooled shaft seal, automatically reversible oil pump, and magnetic oil drain plugs. Carrier Corp.

H

Stockpiler-Loader. Available with plain or cleated belts, this stockpiler-loader is a completely new design. Its stair-channel frame is said to be strong and rigid with simple swiveling wheels making it flexible for all types of unloading and stockpiling service.

Three unit belt carriers mounted on

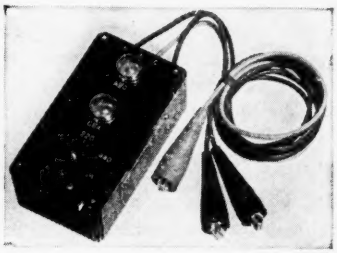


welded steel bases through the belt and minimize belt wear. Antifriction bearings are used throughout. The units are available in a belt width of 24 in., and in lengths of 25, 30 and 35 ft, and can be used for moving all classes of bulk materials—crushed stone, lime, sand, coal, coke, cinders, bauxite, etc. Barber-Greene Co.

J

Phase Sequence Indicator. This new phase sequence indicator makes determination of order in which sine-wave voltages succeed one another, simple, fast, and accurate. For installing and servicing polyphase wattmeters, motors, watthour meters, power factor meters, alternators, transformer banks and other equipment.

Operation is extremely simple. The three leads are connected, and switch



turned to proper voltage. If rotation is CBA, lower light will glow; if ABC, top light will glow.

The lights connected in Y to the circuit, indicate unmistakably the phase order.

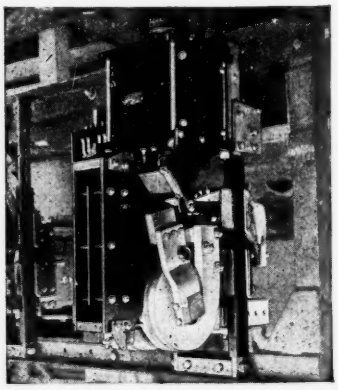
The Model 40 can be used with 115, 200, and 400 v circuits. For greater voltages, special instruments are available on special order. Three leads, three feet long, with rubber insulated clips designated A, B, and C are colored black and red for ease in determining master lead.

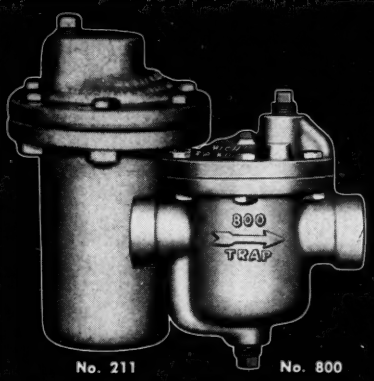
The instrument weighs less than a pound, measures 2 by 3 by 5½ in., and is completely self-contained except for leads. Associated Research, Inc.

K

Contactors. The latest additions to the line of contactors are 1500, 3000 and 6000 amp units for operation on up to 750 v d-c. They are single pole, heavy-duty, magnetically-operated frame mounted, rear-connected contactors with up to 8 heavy duty, normally open or normally closed, double-break auxiliary interlock contacts.

The main contacts are designed with arc tips which force the arc out onto the ribs of the arc runners. The arc chute has a divider to help cool the arc. All parts of the contactor, in-





No. 211 No. 800

Above left — Armstrong bottom inlet—top outlet series trap.

Above right — Armstrong No. 800 side inlet—side outlet trap.

PROOF THAT ARMSTRONG TRAPS PAY DIVIDENDS:

DAILY COAL CONSUMPTION REDUCED 5 TONS by using Armstrong traps.—*City High School, Springfield, Ill.*

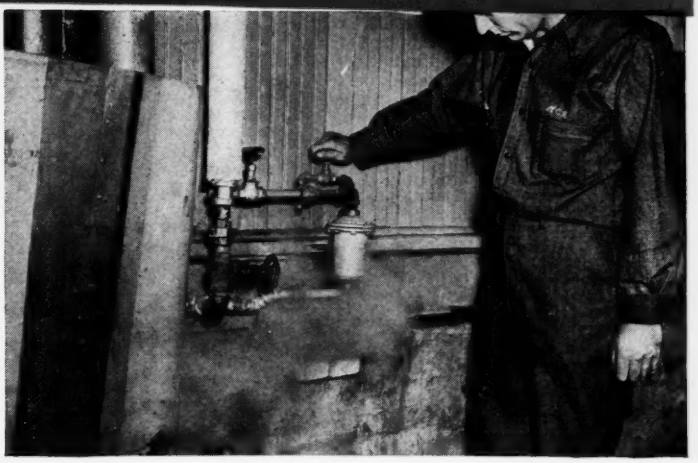
95% MAINTENANCE REDUCTION after using Armstrong traps.—*R. Thomas & Sons Co., Lisbon, Ohio.*

COAL CONSUMPTION CUT 4½ TONS by installing Armstrongs.—*Couch Bros. Mfg. Co., Bell Point, Ga.*

20% MORE PRODUCTION with use of Armstrong traps on kettles and vacuum pumps.—*Mary Lincoln Candy Co., Buffalo, N. Y.*

For Fuel Savings and Maximum Production

INSPECT YOUR STEAM TRAPS REGULARLY



IT WILL PAY YOU handsome dividends in fuel savings and increased production to keep your steam traps in good working order. Inspect them for wear, clean out dirt, check the valves for leakage.*

WORN STEAM TRAPS COST YOU MONEY. Instead of retaining steam in your equipment until it gives up enough heat to condense, worn traps with leaky valves let live steam blow through to the return lines. Much of the heat is wasted instead of being utilized productively. Next time you pay your fuel bill, ask yourself how much heat you can afford to waste. The answer is NONE. Hence you must *repair or replace worn traps.*

GET RID OF THE HORSE AND BUGGY MODELS. Some traps aren't worth repairing. If they require frequent maintenance, if they are large in size and small in capacity, if they don't remove *both* air and condensate as fast as they accumulate, replace them with modern Armstrong steam traps.

The test is: Do they keep your equipment hot without leaking steam and will they do this without frequent and costly maintenance? Armstrong Traps have hardened chrome steel valves and seats and all other working parts are stainless steel, which are suitable for pressures up to 1500 pounds per square inch! That's one reason they seldom need repairs.

IF YOU NEED TRAPS, CONSULT ARMSTRONG. Thousands of satisfied users will testify that Armstrong traps keep machines hotter without wasting fuel and stay on the job longer with less attention.

The ARMSTRONG STEAM TRAP BOOK discusses these features and lists the correct sizes of traps for various services. Send for a copy.

ARMSTRONG MACHINE WORKS

810 Maple Street • Three Rivers, Michigan

*Ask for a copy of the Armstrong Steam Trap Maintenance Bulletin for details on trap inspection and maintenance.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

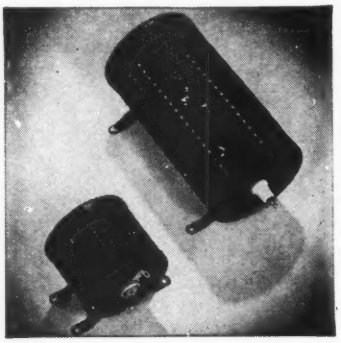
No. 5 of a series of advertisements devoted to improving efficiency through better trapping.

cluding the main and auxiliary contacts are readily accessible.

These new contactors are particularly adapted for frequent starting and control of large direct current motors such as are common in steel mill installations. Allis-Chalmers Mfg. Co.

L

Dummy Antenna Resistors. Production of two new series of dummy antennas has been recently announced. The new units consist of a number of special non-inductively wound, vitreous-enameled resistors connected in parallel and mounted inside a black wrinkle-finished perforated cage. The cage has legs for con-



venient mounting. To make electrical connections, two types of terminals are provided, depending upon whether the unit is intended to be used in conjunction with a coaxial cable or with a parallel transmission line.

Residual inductance and distributed capacitance have been kept to a minimum, making the natural resonant frequency as high as possible. The d-c resistance, residual inductance, and distributed capacitance have been proportioned to give the best possible response characteristics. Ohmite Mfg. Co.

M

Photoelectric Combustion Safeguard. Photoelectric scanner, Type 45PH5, for flame failure protection on oil burners. The equipment guarantees instantaneous burner shutdown in case of flame failure.

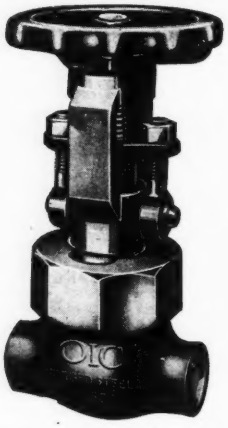
Scanner, Type 45PH5, consists ot phototube and vacuum tube amplifier housed in a compact, dust-tight alumi-

num case. It is mounted on the burner so that it has a clear view of the oil flame. It continuously monitors the oil flame.

Features include an optical system of a special heat-absorbing filter, and a hinged shutter permitting lens cleaning without burner shutdown. The scanner is small but rugged, resulting in the flexibility of location on any burner. Other features are, adaptibility to all oil burner heads, immunity to moisture and electrical leakage, and protection from combustion by-products. Combustion Control Corp.

N

Forged Steel 600-psi Valves. An entire line of 600 psi forged steel valves are available in gates, globes, angles and checks, with various types of trim. Produced in screwed, flanged and socket-weld types, they are easily and safely packed under pressure. End flanges on flanged valves are machined 600 lb

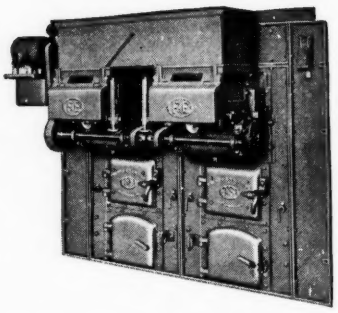


ASA Standard B-16-E, and have a large male face ¼ in. high with a serrated finish. Valves can be furnished with ring joints, small male, large or small female, or large or small tongue and groove facing. All flanges are forged as an integral part of the body and all bonnets are forged in one piece. Every valve is completely tested to the full test pressure. In the globe, angle, and lift check valves the seats are threaded and screwed into the bodies and can be removed and replaced with the simplest of tools. All discs are of the swivel or loose type and are fastened to the stem with a disc stem ring.

The stuffing boxes provide space for plenty of packing. The bonnet connections are generally porportioned with a male and female joint in the bolted bonnet type, and essentially the same type of joints in the union bonnet valves. All of the bonnet joints are fitted with a corrugated soft iron gasket. The union bonnet ring is made of octagonal forged material. The Ohio Injector Co.

O

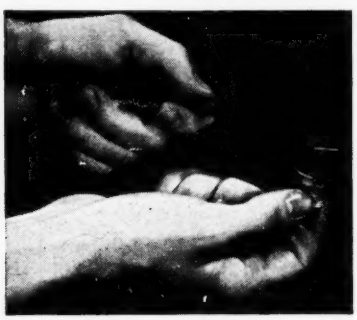
Spreader Stoker. A new spreader stoker, containing many new and improved features, has been developed



by the Flynn and Emrich Co. Features are electro-hydraulic drive, non-bridging coal hopper, sectional coal feed pushers for continuous feed, individual driven coal distributors, steam operated power dumps, sectional grates, and trajectory plate adjustment to regulate coal distribution from front to rear. Flynn and Emrich Co.

P

Bar Hangers. A new heavy-duty fixture stud for S-type bar hangers, which permits outlet boxes to be easily attached, has been announced. Once the stud has been slipped into the center hold of the box and tightened by a single screw, the outlet box is held firmly in place. The S-type bar, hangers come in two sizes--



one for spacings between studs or joists up to 16 in., and the other for spacings up to 24 in. Either will fit in a space as narrow as 6 in. Because the hangers fit between the framing instead of being nailed to the face of the stud, plaster cracks or bulges on the finished walls are eliminated. General Electric Co.

Q

Protective Pipe Coating. This new protective coating resists electrolysis and corrosion. The new material has ductility to withstand severe earth shock or movement, and because of its stability earth pressures will not cause it to slump or creep. Its high flash and fire point, in excess of 500 F and its non-toxic quality, adds to its safety factor.

It will not settle out or "coke-up" after repeated reheating or re-tempering.

Alkalis and soil acids have no appreciable effect, it has a high bonding characteristic to metal or concrete, and high tensile strength. National Petroleum Sales, Inc.

24 YEARS

-for a cent a day

Day in and out, for twenty-four years this Sarco TR-21 Temperature Regulator has controlled the temperature on this large hot water tank in a Cleveland plastics plant.

Because the water for washing and processes has always been "ready to use", oceans of water have been saved during this period. Since the temperature was never too high, car loads of coal were never burned. And in the plant the water for every process was just right, saving thousands of dollars in rejects and building up a life time reputation for the consistent quality of this company's products.

And all this for less than a cent a day — for that is the original cost of the Sarco Control divided by its many days of faithful service. Many Sarco Controls are so inexpensive and effective that their cost is paid for in savings in a few months.

Other Sarco Controls for room temperatures, processes, cooling water and refrigerants are also available.

This Sarco Control operates steam, water, brine and gas valves ½ to 8 in. Entirely self-contained and self-operated. No electricity, compressed air, etc., needed. Easy to install. For any temperature between 0 and 300° F. Write for Catalog No. 600.

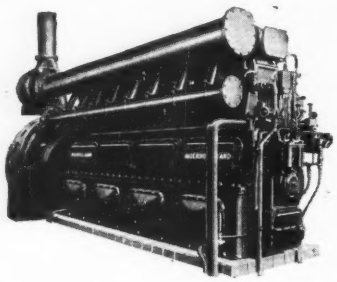
180

SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

R

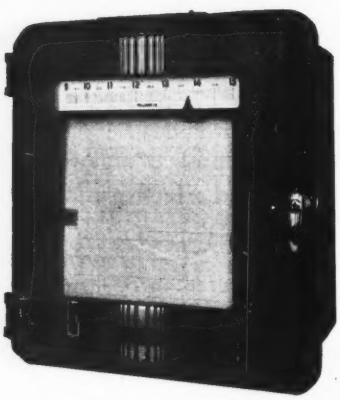
New Supercharged Diesel Engine. Developing 50 per cent more hp than an unsupercharged engine of the same size this new engine by a well-known maker utilizes the advantages of a supercharger driven by exhaust gases. Supercharging scav-



enges the hot exhaust gases from the cyl and replaces it with fresh air under pressure. Operation of the turbocharger is entirely automatic. Use of the turbocharger permits the use of smaller heat exchangers or other cooling methods. Engine is available in brhp of 675, 785, and 900, with 6, 7, and 8 cyl, of 720 and 750 rpm. Ingersoll-Rand Co.

S

Voltage Recorder. Highly legible recording of as many as 16 a-c voltages on a wide strip chart now is possible through the use of a new suppressed range, multiple-point a-c remote indicating voltage recorder. This readibility of scale is due to the use of a suppressed zero range, which ignores that portion of the voltage scale in which the operator is not interested, and spreads the few volts (or kilovolts) which he needs to watch across the instrument's entire chart width.

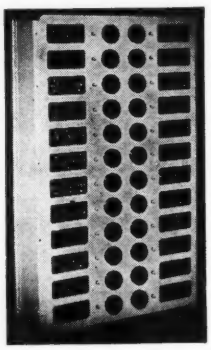


Depending on the speed of fluctuation in the measure voltage, the instrument can either be a Micromax or a Speedomax — the latter used where top speed and sensitivity are required. The instrument can be either a single-point or a multi-point recorder. Standard ranges are available to cover the usual bus, transmission and distribution voltages. Leeds & Northrup Co.

T

Annunciator. This new audible-visual type annunciator is finding applications in power generation and distribution plants as well as in industrial operations. Each annunciator is made up of individual units consisting of a main lamp to provide illumination of the translucent designations; an enclosed pilot light and a control relay. Each unit is jack-connected to the circuit and is mounted on a metal slide to facilitate withdrawal from the annunciator cabinet for service, replacement or for any other reason.

Any number of these units may be combined in a single cabinet to meet the requirements of the user. The annunciator shown is made up of 24 units and measures 43 by 20 in. As the designations on this annunciator

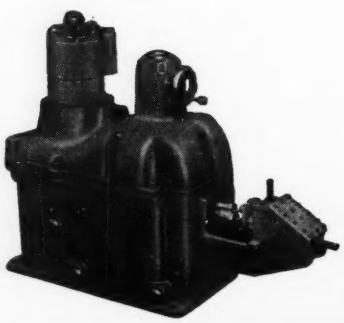


indicate, this equipment will be used in a boiler room. One of the features of the unit is the fact that silencing of the audible alarm for one trouble indication does not prevent the operation of the same alarm in case of additional trouble. The annunciator may be specified for either a-c or d-c operation, with voltages depending upon requirements. Autocall Co.

U

Constant Control Pump. This is a piston type pump developed especially to handle liquids in precisely controlled volume, to deliver at a constant rate of flow (without pulsation), and to pump in minute quantities, down to as little as 75 ml per hr as a maximum for an individual pump.

Flexibility is obtained by the use of interchangeable gears to vary capacity. Features are: availabliity of



various corrosion resistant materials for liquid ends, liquid ends and plungers interchangeable. All of which means the pump will be highly advantageous for full scale production because capacities can be changed at will by use of the change-speed gears and liquid ends can be selected to meet practically any requirements. Milton Roy Co.

V

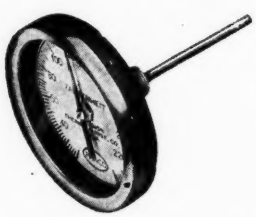
Photoelectric Combustion Control. This unit is a photoelectric control which observes the visual density of the blue gas of oil-burning installations using No. 5 or No. 6 oil, and automatically adjusts the air supply when necessary. The result is highest practicable combustion efficiency without the usual hazard of smoke regardless of wind, barometer, fuel oil temperatures, etc.

Equipment consists of an electronic eye, a control panel which also indicates combustion conditions at all times, and a secondary air door motor

which is controlled by the instruments in the panel. No other auxiliary equipment or meters required. The control is particularly applicable to horizontal rotary cup burners, but may also be used with steam or pressure atomizing burners using No. 5 or No. 6 oil. Bulletin No. 10 is available from General Power Plant Corp.

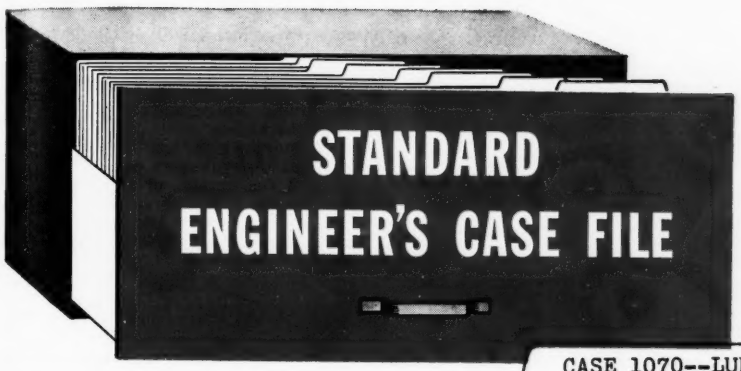
W

Easy Adjustment Dial Thermometer. Unique case construction and simplified adjusting devices permit easy re-setting of a new dial

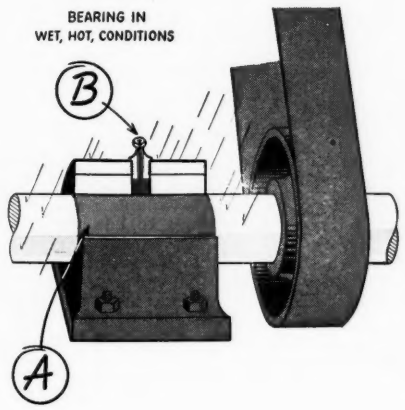


thermometer. Its case is supplied with either a moisture and fume proof frame or a quick opening threaded frame. With either type, adjustment of both dial and pointer to any point within a full 360 deg. may be made from the front while the instrument is in service. No tools other than a small Allen wrench and an ordinary screwdriver are required.

The four-inch dial of the bimetallic-



CASE 1070--LUBRICATING GREASE BEARINGS IN HEAT AND MOISTURE.



In a heavy water spray and high ambient temperatures, Calol W. P. Grease maintained good bearing lubrication for full lubrication periods. Very satisfactory on wicket gates of hydro-electric turbines, coal loader arms, hot bed and conveyor bearings in water conditions, cannery and bottle-washing equipment.

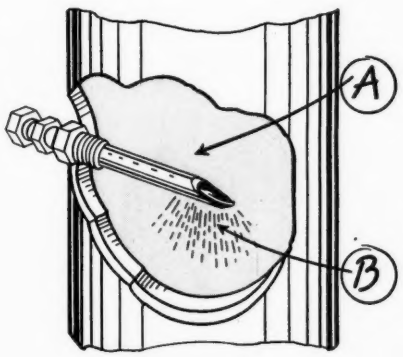
A. Extremely adherent to metal surfaces ... maintains tough lubricating film.

Calol W. P. Grease will not melt or dissolve in boiling water. Resists all heat in a peculiar manner - gradually softens over long range of temperatures instead of melting suddenly as most greases do.

B. Medium-bodied -- may be applied by grease gun or cup. Good pumpability in low temperatures.

Calol W. P. Grease contains no talc, resin, wax or other fillers.

CASE 1040--SECURING SAFE LUBRICATION IN STEAM ENGINES IN WIDE RANGE OF CONDITIONS.



LUBRICANT ATOMIZING QUILL

Compounded Calol Cylinder Oil — 155PX provided adequate lubrication with freedom from carbon in various steam engines operating with temperatures from 375° F. to 550° F. Made from 100% Pennsylvania steam cylinder oils and special acidless tallow oil. Medium viscosity grade.

A. Economical in steam conditions from saturated to moderate superheat.

B. Atomizes readily in steam.

Calol Cylinder Oil — 155PX will separate easily from exhaust steam and condensate where adequate oil separators and skimming equipment are installed.

Calol Cylinder Oil — 155PX is one of a complete line of steam cylinder and valve oils produced by Standard of California.

For additional information and the name of your nearest Distributor, write

TANDARD OIL COMPANY OF CALIFORNIA

225 Bush Street, San Francisco 20, California

The California Oil Company
30 Rockefeller Plaza, New York 20, N. Y.

The California Company
17th and Stout Streets, Denver 1, Colo.

Standard Oil Company of Texas
El Paso, Texas

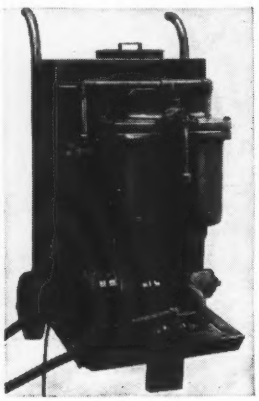
RPM CALOL

Trademarks Reg. U. S. Pat. Office

actuated thermometer is available in eleven standard scales, covering a total range of 100 to 850 F or C equivalent, with an accuracy of 1 percent at any point of indication. Thermometers are supplied with stainless steel stems in four standard lengths, 4, 6, 9, 12 in. Separable sockets for these stem lengths can be furnished in standard metals. Precision Thermometers Instrument Co.

X

Portable Oil Flusher. Internal cleaning of machinery without disassembly by skilled mechanics is now possible through the use of this new portable oil flusher. By means of a high pressure nozzle jet, organic solvents, kerosene or lubricating oil can be shot through the inspection or clean-out openings of housings around bearings, gears or cranks. Thus it is possible to loosen dirt, sludge or wear particles or force out water. Through



a safety control device, the flow may be reduced to a gentle flushing stream if desired.

The unit consists of a tank for holding and carrying the flushing fluid to and from the machine to be cleaned; a pump and driver for actuating the fluid; a filter for collecting the refuse cleaned out, and hoses, piping, valves and safety pressure control. It is possible to use the unit as a simple lubricating oil circulating system. Fox River Tool Co.

Y

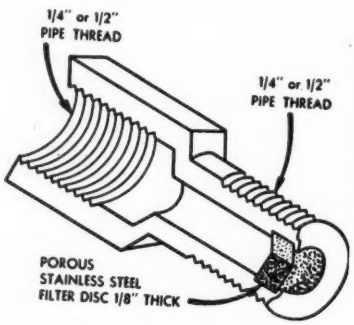
Strainer. A new high pressure Y-type strainer for pressures up to 600 lb has been added to a line of "Y" strainers made by this firm. This high pressure strainer is made with threaded flanged or welded connections in many standard sizes or to specifications. The outstanding feature of this strainer is its design which reduces pressure drop through the strainer to a minimum. This unit is suitable for close quarter installations, as well as normal installations, since the perforated strainer sleeve fits snugly into the body.

This unit is provided with a bolted blow-off connection for blow-down cleaning, and each strainer is hydrostatically tested according to service

conditions under which they are required to operate. Manufactured in various metals including cast bronze, brass, cast iron and cast steel. Available with a magnetized strainer plug for intercepting small ferrous particles. J. A. Zurn Mfg. Co.

Z

New Pressure Snubbers. Snubbers eliminate pressure gage fluctuations caused by pressure pulsation and vibration. By completely smoothing out pressures they cause gage to indicate steady average pressures, and protect the indicator mechanism against undue shock and wear. Feature is the porous stainless steel filter disc. The disc provides a large filter surface which prevents clog-up in pres-



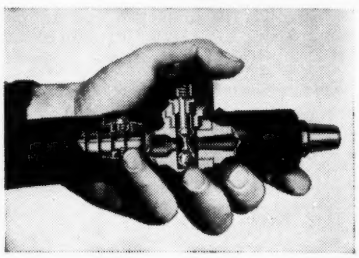
sure gage service. Specially designed filter discs are available for air, oil, water, mercury, etc. Excellent mechanical design permits easy installation of the snubber into any pressure line for instrument protection, and as a protective medium for preventing mercury losses from manometers. Maximum differential pressure rating of the standard types is 500 psi. Snubbers for use up to 5000 psi can be supplied. Equipoise Controls, Inc.

AA

Palm Size Hose Valve. A new palm-size, hose valve for use in a variety of industries has been announced. It operates without springs and with only two moving parts, the operating plunger, and the controlling ball.

The hose nozzle is discharged by pushing a button. This causes the plunger to roll the ball off its seat, giving instant full flow. At 50 psi hose pressure, less than 10 lb finger pressure on the button opens the valve, giving aproximately 13 gpm through the nozzle.

When the push button is released, the difference in pressure between the center and the outside of the stream forces the ball into the valve throat, closing the valve and raising the push button plunger. The ball is held firmly



against the seat by line pressure, making a line-contact seal.

The valve is available for standard hose sizes from ¼ to 1 in., delivering up to 13 gpm at 75 psi line pressure. Made entirely of Monel, including the ball and the plunger, for maximum resistance to corrosion and wear, the body is rubber coated. One model is fitted with a threaded replaceable nozzle that adapts the valve for use with long extension nozzles. Paul Valve Corp.

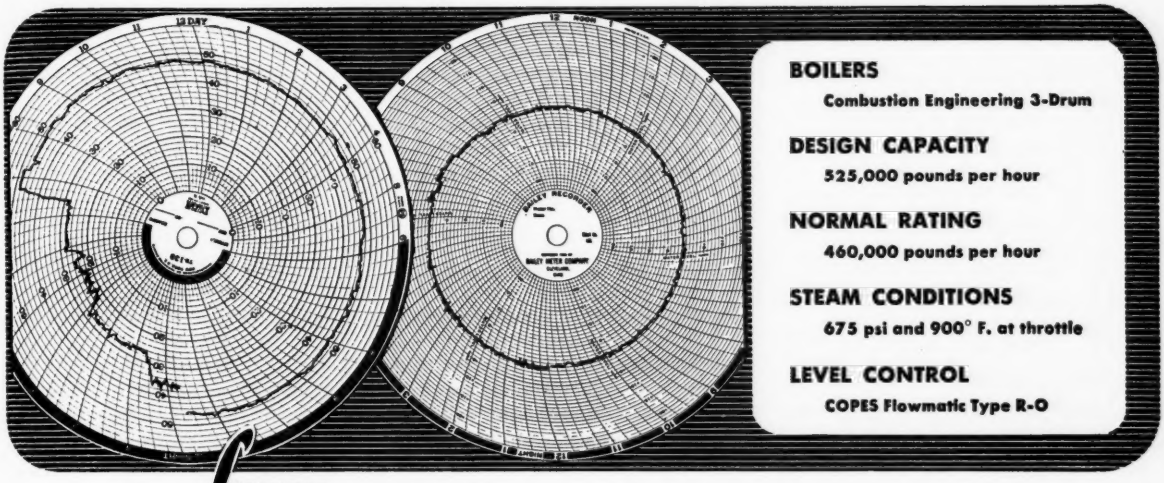
BB

Dry Contact Selenium Rectifiers. These new selenium rectifiers are vacuum impregnated, silicone and fiberglas insulated, oil filled, water cooled, and sealed in stainless steel. Uneffected by ambient temperature, climate, altitude, fumes, dirt or neglect, new materials and improved contact result in temperature stability

and regulation over a wide load range. Low voltage tubes, and large steel tank polyphase units have multiple plug connectors. Available in half-wave tubes, single and polyphase tubes, and polyphase tanks. Clark Electronic Laboratories.

FLOWMATIC *Welcomes*

SUDDEN CHANGES IN LOAD



BOILERS
Combustion Engineering 3-Drum

DESIGN CAPACITY
525,000 pounds per hour

NORMAL RATING
460,000 pounds per hour

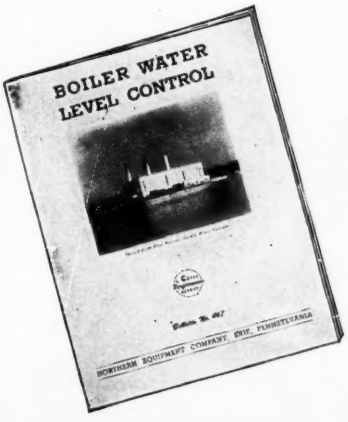
STEAM CONDITIONS
675 psi and 900° F. at throttle

LEVEL CONTROL
COPES Flowmatic Type R-O

from **460,000 down to 320,000 pounds per hour in 15 minutes . . . 280,000 up to 400,000 pounds an hour in another 15 minutes . . . and level held closely . . .**

No matter how rapidly or widely your boiler load changes, you can be sure of a stable water level in the drum if you depend on COPES Flowmatic for boiler feed control. Users also say adjustments and maintenance are easy for the plant personnel.

NORTHERN EQUIPMENT COMPANY
482 GROVE DRIVE, ERIE, PENNSYLVANIA
BRANCH PLANTS in Canada, England, France and Austria
Representatives Everywhere



Charts above are from Performance Report, Bulletin 467. Write for your copy today.

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

SMALL TRAP
BIG *Performance*

Little? Sure. But what a giant's job they do:

That's how men judge Yarway Impulse Steam Traps.

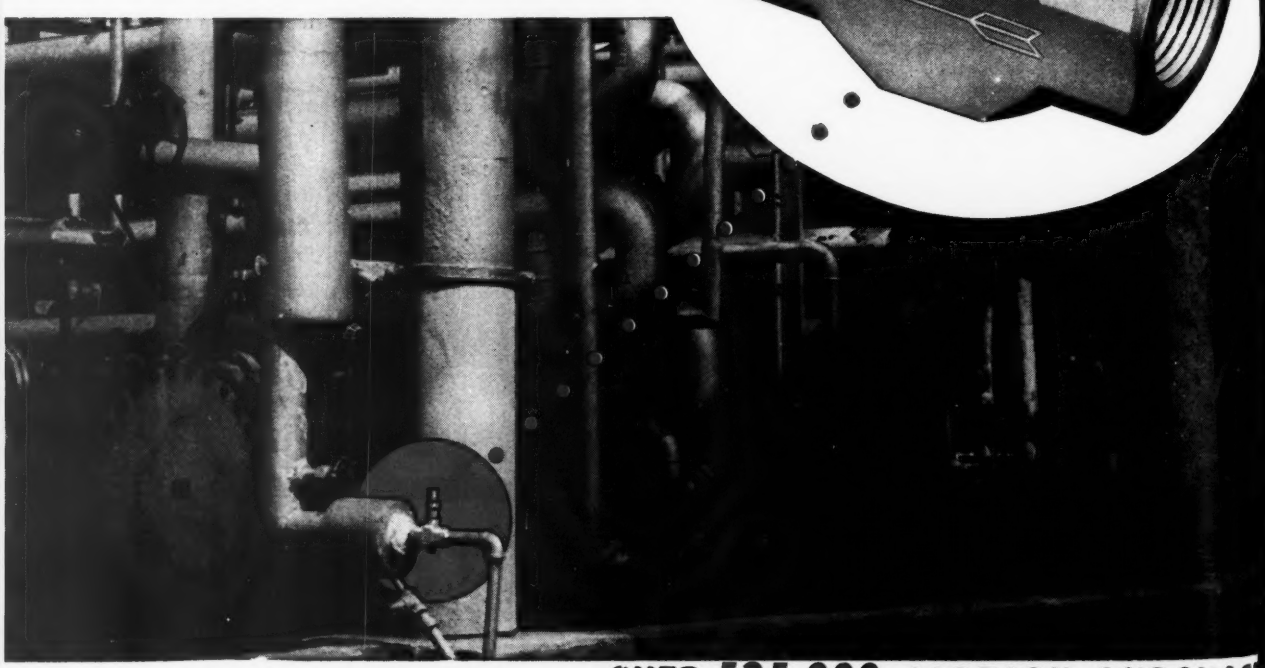
Yarways are well suited for trap service throughout industry. The small size itself is an important feature. They are easy to install, fit in anywhere, require no special supports.

In service they *drink* condensate, discharging *continuously* on heavy loads, at short *intervals* on light loads—providing maximum heat in the shortest time, and keeping equipment at top efficiency.

Yarways are suitable for all pressures without change of valve or seat. Simplicity of construction (only one moving part) minimizes maintenance. Also, initial cost is low.

Try some Yarways today—standardize on them tomorrow. See your nearest Supply House or write for Yarway Bulletin T-1739.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.



OVER 525,000 ALREADY PURCHASE

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Why Turbulence Is Important to Engineers

By JOHN S. McNOWN

PRIOR TO a discussion of turbulence, which is readily seen to be of practical as well as scientific interest, it is desirable to define the subject: Turbulence is a state of fluid motion in which every element of the fluid has a more or less random motion. It follows that periodic occurrences would not fall within this classification; so that an orderly wave pattern or the trail of vortices from a canoe paddle would be excluded, although the motion of the water some distance astern of an outboard motor would surely be classed as turbulent. Also, if the waves should break as they approached a beach, or if the orderly vortex pattern were to be upset by natural interference the resulting motions would fall within the foregoing definition of turbulence.

In each of the cases cited, the turbulence could not be called entirely random. The term "turbulence" is seen to be merely a classification, so that certain characteristics, such as the effective size of the eddies and the average turbulent velocity, must be evaluated before the state of motion can be definitely specified.

In addition to these quantities, a diffusion coefficient (similar to the molecular diffusion coefficient, although many thousand times larger) has been defined, which is equal to the product of the turbulence scale and intensity and is a direct indication of the degree of mixing in a given state of flow. One further means of characterizing turbulence is by determining a frequency spectrum of the turbulence energy; the fluctuations occurring within a given period represent a certain fraction of this turbulent enegry, and a continuous plot of this distribution of energy with frequency is indicative of the type of turbulence.

How Turbulance Theories Are Applied

It is of interest to point out the extreme diversity of the scientific applications of turbulence theories. Our topsoil is transported by rivers through the action of turbulence in much the same manner as water vapor is transported by air currents. Heat transfer in a boiler tube is greatly accelerated by turbulence, while medical scientists have long speculated as to whether or not the same process in the main arteries of our bodies is aided by turbulence. Chemical engineers, concerned with the mixing if liquids, speed up the process by maintaining turbulent flow and an oceanographer has recently been estimating the rate of turbulent diffusion of radio-active material from the site of the Bikini bomb test. The rate of energy dissipation resulting from turbulent motion is of equal importance to the designers of water-supply systems and the designers of airplanes.

Neither the allotted time nor the information at the disposal of the writer would permit a summary of recent developments in this field, which has proved to be so broad. It should suffice, however, to illustrate current trends by citing typical advances in instrumentation and analysis, the principal lines of development.

At a number of hydraulic laboratories, an instrument has been sought that will permit the direct measurement of the turbulence parameters in flowing water in much the same manner made possible in air flow by the hot-wire anemometer. Two methods have been proposed recently that show definite promise. One, developed at Columbia University by Dr. Kolin makes use of an electromagnetic field, the variations of the electric current induced in the water due to its motion through the field giving a direct indication of the instantaneous rate of flow. A second instrument, still in the development stage, consists simply of two wire electrodes placed a small distance apart. The electric current flowing from one to the other was accidentally found to vary with the instantaneous velocity, and subsequent investigation showed the cause of the variation to be the changes in the rate at which ions were washed from the electrodes by the flowing liquid. Although not yet proved as a reliable field instrument, the device has yielded promising results in the laboratory for the measurement of instantaneous velocities.

Analyses have been made of several problems which have led to useful results when combined with experimental verification. Of particular importance during the large continental raids by British-based bombers was the study of fog dispersal by heating the air above landing fields. The heated air rising from the burners through the oncoming wind resulted in a gravitational diffision, which raised the temperature of a large volume of air the few degrees necessary to evaporate fog. The combination of burner location and quantity of heat from a given wind velocity and a required temperature rise was found through a combination of systematic experiments and analysis after the so-called FIDO project had been in operation on a trial-and-error basis for several months. The results of this analysis are equally applicable to the downward diffusion of a heavier gas or, for that matter, to the diffusion of silt-laden or cold water from the surface of a flowing stream.

Studies of Jets

The pattern of mean flow and turbulence diffusion caused by a submerged jet has been the subject of recent investigations at the California Institute of Technology and at the Iowa Institute of Hydraulic Research. While the aeronautical engineer is

(Continued on page 126)

John Stephenson McNown is research engineer in the Institute of Hydraulic Research and associate professor of mechanics and hydraulics at the State University of Iowa, Iowa City, Iowa. He was born in 1916, in Lawrence, Kansas; his father was W. C. McNown, also a professor in the field of civil engineering. John S. McNown received his B.S. degree in Civil Engineering at the University of Kansas in 1936, his M.S. degree in Hydraulics at the University of Iowa in 1937, and his Ph.D. in Hydraulics at the University of Minnesota in 1942. He was instructor of mathematics and mechanics in the University of Minnesota Engineering College from 1937 to 1942 and during the following year worked on oceanographic problems related to detection of submarines by sonic methods, as Research Associate (NDRC) in the Division of War Research of the University of California. He returned to the University of Iowa in 1943. He has conducted research projects related to turbulence, cavitation, and pressure distribution; much of the research was sponsored by the U.S. Navy. He is a member of Sigma Xi, Tau Beta Pi, ASCE, Iowa Engineering Society, and ASEE.

Power Plant Improvement at

This detailed and concise story of how an old and run-down power plant was improved by the expenditure of very little money should be of interest to many owners and operators of similar run-down plants. At a total cost of around $70,000 for improvements, the new equipment, it is expected, will pay for itself in a few years

By DENARD L. GUSLER

THE STANLEY FURNITURE CO., Inc, located at Stanleytown, Va., consists of two factories located side by side to form one unit. Bedroom furniture is manufactured in one factory and dining room in the other. Early in 1946 the Plant Management decided that the time had arrived when something should be done about the operating costs of the power house. The plant owned sufficient steam and electric generating equipment yet purchased power costs were excessive. There was a plentiful supply of waste wood for the boilers yet considerable tonnage of coal was necessary to keep the plant running. Since the equipment was adequate it was evident that what was needed was a general improvement in the power plant efficiency. The first improvement made, however, seemingly had very little to do with the power plant.

Maintenance was taken care of in the small shop shown in Fig. 2. The space limitations of this shop are clearly evident. The equipment was of ancient vintage and poorly maintained. It was actually impossible to thread a full length of pipe without letting it extend through a hole in one wall. The shop had a rotten wood-en roof that leaked like a sieve. All welding equipment and cables rested on the floor. The floor was a packed dirt affair. Tool boxes were scattered at random. The location of the shop was excellent both with respect to the factories and the power plant.

It was decided to enlarge the machine shop as shown in Fig. 3. A 24-in. beam was introduced to carry the building above the machine shop and to also support structural steel roof trusses. New equipment was purchased throughout and distributed to provide maximum service. All tools are contained in the tool and work bench in drawers that open from either side. Where necessary or desirable equipment was made portable. Advantages offered by the new shop are easily apparent particularly the fabrication area where considerable pre-fabrication was possible for the construction that was to follow. During the building of the machine shop steps were being taken to determine exactly what should be done to the power plant.

The boiler room equipment and attendant building arrangements are shown in Fig. 1. The three HRT boilers with a combined BHP of 790 supplied steam to the generating equipment and for various heating purposes. Fine dust and shavings were picked up by a large exhauster in each factory and blown to individual dust collectors of the cyclone type located on the roof above the boilers. The collectors discharged by gravity through a division valve arrangement to the boilers. Miscellaneous sticks and other wood refuse was trucked to the boiler room and stacked in the stacking area or hand-fired, usually by the man who happened to be pushing the truck. Coal was hand-loaded and wheeled in from around the stack. Draft was controlled by opening the ashpit doors. This method of firing resulted in fuel beds as much as three feet thick and smoke as dense as a coal seam.

A test was run in June, 1946, to find out how much wood was trucked to the boiler room to be hand-fired. It was found that 72 trucks were handled with a total weight of waste wood of 24,988 lb. 51 trucks were hand-fired into the boilers and 21 trucks were stacked in the stacking area. Stacked fuel occupied a space of about 825 cu ft leaving a working lane 6 ft wide in front of the boilers. At times this space was occupied by as many as four men unloading trucks. Boiler No. 1 popped off 16 times for a total time of 2.8 hr which represented a steam loss of 19,600 lb. An additional test was made to determine the boiler efficiency. The low value of 48.4 per cent was finally arrived at. These tests merey substantiated facts that were generally known and also provided data necessary for the purchase of equipment.

Immediately after the above tests the plant management in conjunction with Mr. C. H. West of Massey, Wood, and West, Richmond, Virginia, decided on the equipment necessary to step up the power plant efficiency.

The arrangements worked out are shown in Fig. 4. Wood is manually fed from factory trucks to a size 20 S Williams wood pulverizer which is located centrally between the two factories. A type E, size 400, American Blower driven at 1620 rpm by a 20 hp motor picks up the hogged refuse and blows it to a 20 ft dia type S80 Kirk and Blum dust collector set above an 18 by 20 by 31 ft wood vault. This collector also collects dust from

The improvements in the power plant of the Stanley Furniture Co. described in this article have an interesting history. They resulted from long-range thinking of the author when he was on active duty in the Pacific in the U. S. Marine Corps. Mr. Gusler, it may be recalled, has been a frequent contributor to these pages during the past 8 years. Still a young man, before the war he had considerable experience as an operator in industrial power plants. A former Marine, he re-enlisted in the U. S. Marine Corps at the beginning of the war and specialized in the field of electronics. Despite his military duties he continued to turn out a constant stream of articles. In January 1944 we published an article by him on a post-war power plant for furniture factories. It was in this article that Mr. Gusler worked out many of the ideas incorporated in the present Stanley Furniture Plant. Upon his return to civil life a little over two years ago, Mr. Gusler proceeded to carry out his ideas and it was under his direction and guidance that the project at Stanley Furniture Co. was carried out. Mr. Gusler's intimate knowledge of power plant operation, coupled with his insatiable desire for engineering knowledge and an ambition to succeed should carry him far in the field of industrial power plant design and construction. If you are interested, you will find a short biographical sketch of Mr. Gusler in the January 1944 issue

Stanley Furniture Company

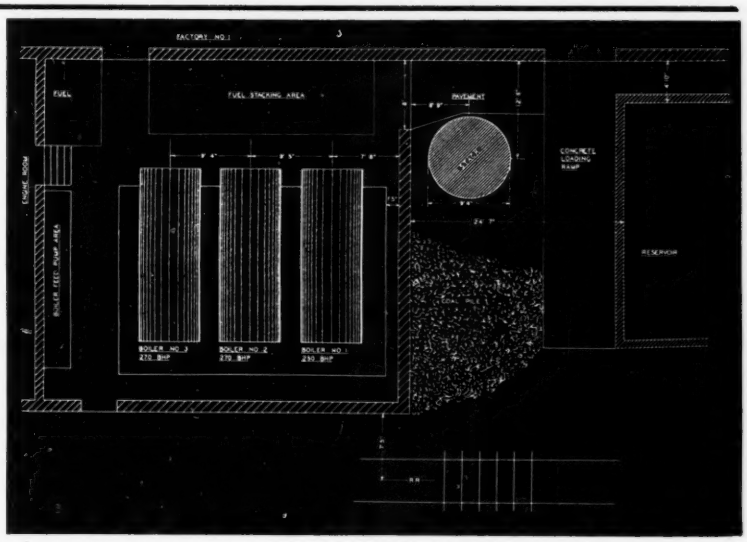


Fig. 1. Boiler room equipment and attendant building arrangement before the improvements were made. Three HRT boilers with a combined boiler horsepower of 790 were installed as shown

both factories therefore replacing all other collecting equipment. Inside the wood vault there is a steel hopper converging on a 20 in. wide mesh conveyor. To facilitate the flow of fuel, in case of stoppage, a Syntron vibrator is mounted on the underside of one slope. The conveyor is driven by a size 00 Reeves drive, the variable speed being automatically controlled by a Hagan receiver piston through a set of reduction links. The conveyor discharges to a triple hopper provided with division gates so that fuel may be supplied to the boilers collectively or in any combination. The removal of this fuel from the hopper is taken care of by three Sturtevant, size 35, exhausters operated at 1500 rpm by 5 hp motors. The fuel is blown to 3 no. 12 Px Kirk and Blum dust collectors set above each boiler in the steel framework left vacant by the removal of the old collectors. From the collectors downspouts effect a single entry into each boiler. Distribution of the fuel on the grates is assisted by wood distribution fans that blow a jet of air under the incoming stream of wood fuel.

Coal, ⅝ to 1¼ nut and slack, is removed from the coal car by means of a Chicago Automatic Conveyor having a capacity of 20 to 25 tons an hour. This conveyor is driven by a three horsepower 110 v motor which makes it a portable device that may be plugged in where this common voltage is available. The conveyor empties to a Jeffries Bucket Elevator of 30 tons hourly capacity driven by a 5 hp motor. The bucket elevator empties into a 16 ft dia coal silo 47 ft high. Three Iron Fireman Stokers are set into the coal silo. Each stoker is capable of handling 1600 lb of coal an hour on maximum feed. Hot air is picked up from static space in the furnaces and blows the coal back to the furnaces as it comes off the end of a worm drive. The next problem that arose was where to locate this equipment. Further study of Fig 1 reveals serious space limitations.

The boiler house is bordered by the factory, the engine room, the railroad, and the stack and reservoir completing a circle that is apparently invincible. Furthermore it was decided that all equipment should be located as close to the boiler house as possible. The only direction left, in which to expand, was up and surprisingly enough, as shown in Fig 5, that is just about what happened. This arrangement was arrived at more by necessity than by choice but the results is a fuel feed room containing a symetrical arrangement of machinery that is completely separate from the boiler room yet readily accessible for inspection, operation, and maintenance. The area in front of the boilers was left clean and uncluttered

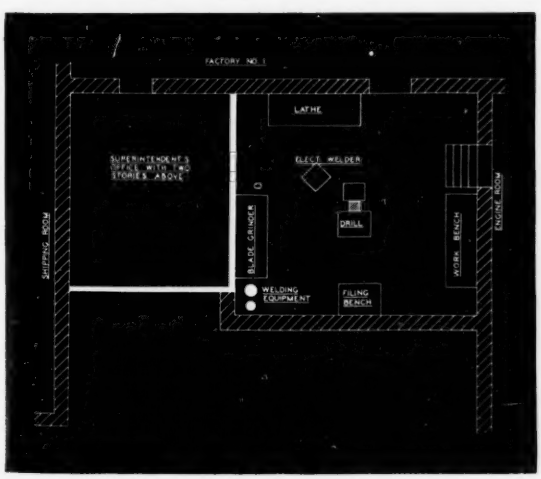


Fig. 2. The small shop used for maintenance work

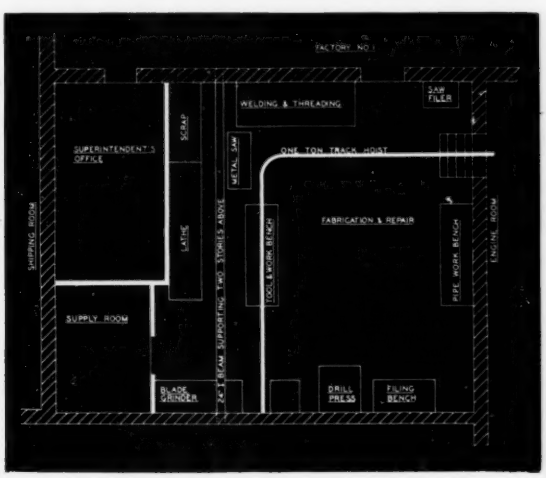


Fig. 3. The arrangement in the enlarged shop

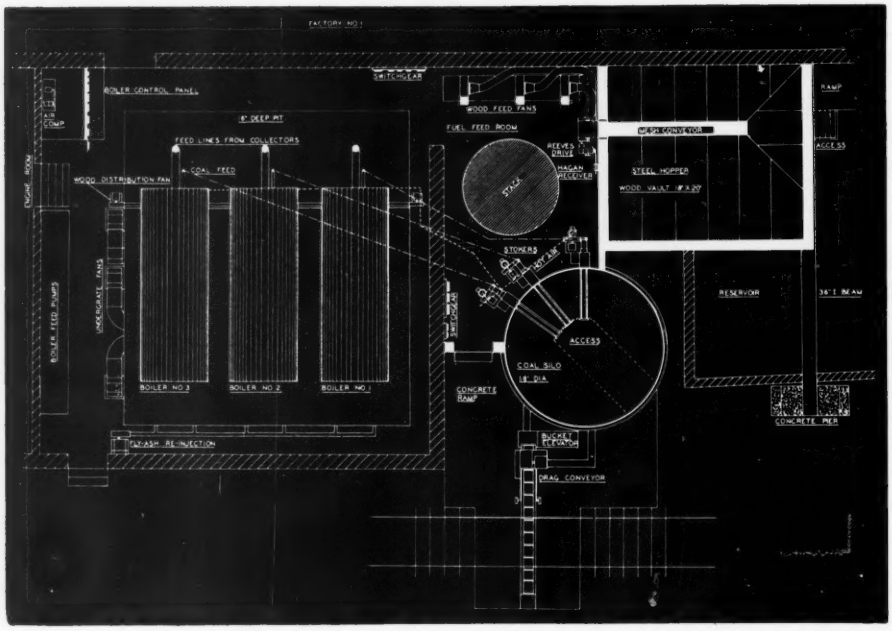


Fig. 4. This is a plan of the arrangement developed for the improved plant. Wood is manually fed from factory trucks to a size 20 Williams wood pulverizer located centrally between the two factories

which is as it should be. If, in the future, it becomes necessary to install new boilers it will interfere in no way with the automatic fuel feeding equipment.

All switchgear is installed adjacent to the machinery that it controls. All automatic and transfer instruments as well as indicating instruments are located on the boiler control panel. The only machinery actually mounted on the boiler setting are the wood distribution fans. Hagan draft regulators (not shown) are located on the wall high up opposite the front of each boiler and are connected by linkage to the stack dampers. Iron Fireman undergrate fans driven by 3 hp motors are installed in the passageway opposite the boiler feed pumps. The fly-ash re-injection blower discharges to a 4-in. header and thence through 3-in. drops to the fly-ash reinjection hoppers. Hot air for the stoker blowers is drawn through a 10 in. pipe and a 10 in. manifold, a temperature of 500 to 700 F being maintained. An access tunnel of brick and re-inforced concrete is provided in the coal silo for lubrication of the rear stoker gearing. Access is provided at the rear of the wood vault for servicing the conveyor bearings and maintenance of the Syntron vibrator. The controls for the vibrator (not shown) are located on the wall just under the Hagan receiving regulator.

In order to leave the reservoir undisturbed two re-inforced concrete piers were sunk on either side of the reservoir and a massive 36-in. I beam installed as shown. This beam was unloaded and set using only a railroad jack, a block and tackle, a one ton hoist, and a small amount of timber. The beam supports one-half of the entire structure, the opposite side resting on a concrete footing. The wall next to the railroad rests on a 24-in. I beam and the remaining wall is factory No. 1. Fifteen inch I beams support the concrete floor. The steel hopper was an afterthought and installed after the building was completed. It is a steel structure consisting of 12-in. I beams, 6-in. H columns, and ⅜-in. steel plates. It was prefabricated by the Roanoke Iron and Bridge Co. of Roanoke, Virginia, and carried in piecemeal through the 48-in. opening through which the conveyor extends. It was then reassembled in the wood vault. The dust collector framework is anchored to steel plates under the re-inforced concerete roof which are in turn anchored through 1⅛-in. tie rods connected to plates embedded in the brick walls at each corner twenty-one feet from floor level. A wind-storm would have to carry away the top ten feet of the wood vault or shear the bolts before damage could be done.

The odd arrangement of the stokers was necessary in order that the worms might be removed if necessary. These worms come out from the front and space immediately in front of the stoker is necessary.

The bucket elevator was assembled on the ground as a unit and a 50 ft railroad crane was brought in on the siding by the Norfolk and Western Railway Co. of Roanoke, Va. This crane raised and set the bucket elevator in about three hours thus saving many days of scaffolding, hoisting, and attendant hazards.

The boiler control panel Fig. 11 was designed and built by the author. It is made up of ⅛-in. sheet iron welded to a 3-in. channel iron frame. The arrangement of equipment is self-explanatory and is presented here as a possible pattern to others who might want to construct their own panels. All indicating instruments should be kept away from the boiler setting and

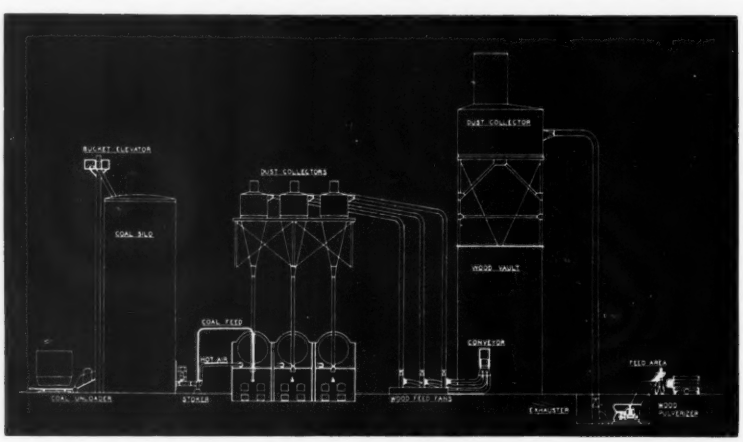


Fig. 5. The only direction left, in which to expand, was up; surprisingly enough, that is just what happened

grouping them all together on a single panel provides for maximum efficiency of operation. The on-off-auto switches are made by Westinghouse The coal and wood controls are Mercoid pressure controls such as used on water pumps. The signal lights are the simple panel lights used in hospital corridors. They are visible even in a very bright light.

The necessary control circuits as well as the power circuits for one boiler are shown in Fig. 12. Tracing through the diagram we find that the stokers can be operated manually or by switching to automatic they can be controlled by the Mercoid coal control. Steam pressure is controlled, as explained elsewhere, by Hagan combustion control, the Mercoid switches merely acting as auxiliary and emergency controls. For example; the coal control might be set for a pressure of 135 lb. Above this pressure it cut off. The Hagan combustion control might be set to maintain a pressure of 144 psi. If the wood gives out and the pressure starts to drop the coal control will cut in and fire the boilers on coal until wood is again available. On the other hand if there is plenty of wood and the steam demand suddenly drops, as when the plant shuts down at night, the Hagan control will slow the Reeves drive to minimum; however, the steam pressure might still continue to rise. In this case the wood control will cut off the undergrate fans and the Reeves drive just under the 'pop-off" pressure. With this set-up the danger of poping-off is virtually eliminated. It will be noted that in case of low water the undergrate fan is automatically cut off and if the water cannot be brought up the fireman can easily cut off the fuel feeding equipment. The signal circuit was designed to provide a reasonable degree of protection without going to the extreme A 6-in. bell will ring if any signal lights up. This calls the fireman's attention to the board in case he is busy or in case he isn't in the immediate vicinity. The middle level fuel indicator stays lighted all the time except when fuel rises above the middle of the wood vault. The low level and water supply signals are not connected at the present time. The shear pin alarm indicates a stoker failure.

The Hagan Combustion Control Fig Fig. 14, is that necessary for the control of one boiler. Steam pressure acting on a spring opposed lever generates a control pressure that acts on the Reeves drive receiving regulator to vary the conveyor belt speed with changes in the steam pressure. This control pressure also acts on a diaphram operator that positions a damper in the forced draft air duct thus controlling the air supplied to the furnace. The balanced float regulator controls the furnace draft by positioning the stack damper. This type of combustion control is highly

(Continued on page 84)

Fig. 6. View in the old boiler room showing the cramped conditions. Wood fuel was stacked in front of the boilers

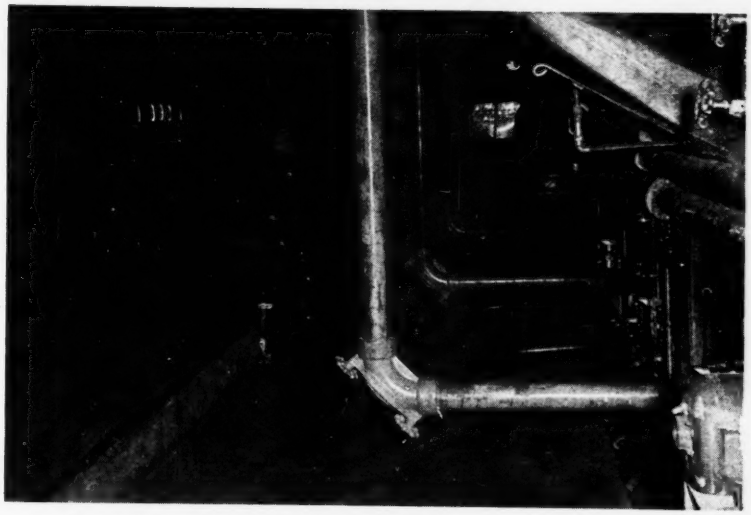


Fig. 7. View in the boiler room after the improvements had been made

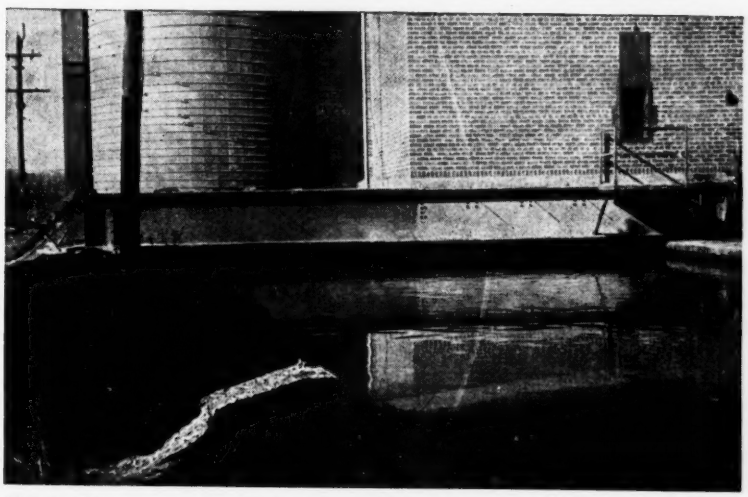


Fig. 8. Close-up of the massive beam and the lower section of the structure it supports. Coal silo can be seen at left

Regenerative Reheating Possibilities in Steam Turbines

How reheating of steam in last stages of steam turbine with bleed steam in hollow blades can reduce losses caused by moisture . . . High maintenance and replacement of blades and other parts of steam turbines and associated loss in efficiency result from moisture in turbine stages below dew point . . . Physical arrangement of turbine described for regenerative reheat . . . Drainage methods now used in turbines may remove less than 5 per cent of moisture . . . Data given on a typical 1250-psi 950-F turbine, passing 300,000 lb. of steam an hour, show loss of 1716 kw due to moisture, and of this 680 kw could be recovered by regenerative reheating . . . Bleed steam is available with little complication; hollow blades can be made, entire method is simple . . . In view of present interest in reheat, here is an attractive possibility

By **W. E. CALDWELL** Mechanical Plant Engineer, Consolidated Edison Co. of New York, Inc.

REPLACEMENT of exhaust blades and shields in steam turbines is recognized as a major maintenance problem; and the moisture that causes it is also the source of less obvious but more significant losses. Since the erosion rate increases with load, service hours and moisture increase, the problem may become more troublesome.

Design refinements, drainage and choice of better materials for turbine construction have aided; but maintenance is still a serious problem, especially the loss of capacity during maintenance outage periods. Approximate distribution of water in the turbine may be determined by studying the erosion pattern within the unit. In the stages just below the apparent dew point, inspection indicates a fairly uniform distribution of moisture during operation, presumably as an atomized mist. In the lower stages, especially the last three, a large part of the moisture concentrates as solid water along the outer portion of the blades. This progressive concentration of water in a comparatively narrow band results in a localized erosion attack on the moving blades or shields, necessitating premature replacement.

Amount of Moisture and Its Effects

Figure 1 depicts typical last stage bucket erosion in a turbine with modern blade materials and calculated average moisture of 11 per cent entering the stage. The dissipation of energy in this attrition process and the resultant effect on blade performance are easy to visualize. In addition to the conspicious evidence of localized wear, serious erosion and roughness on the remainder of the blades is discernable.

While the calculated average moisture in the affected stage may be but 11 per cent or less, the actual ratio of water to steam in the region of localized attack is much higher, due to the segregation caused by centrifugal force and other influences. This effect has long been recognized and stage drainage arrangements have been provided in the wet stages of turbines for a number of years. So far, drainage mechanisms have been relatively ineffective in removing moisture. In one large 1800-rpm low-pressure turbine, the maximum amount of water removed, as found by measurement, was 4000 lb per hr from a stage where 90,000 lb of moisture per hr was known to be passing, or the effectiveness of drainage was less than 5 per cent.

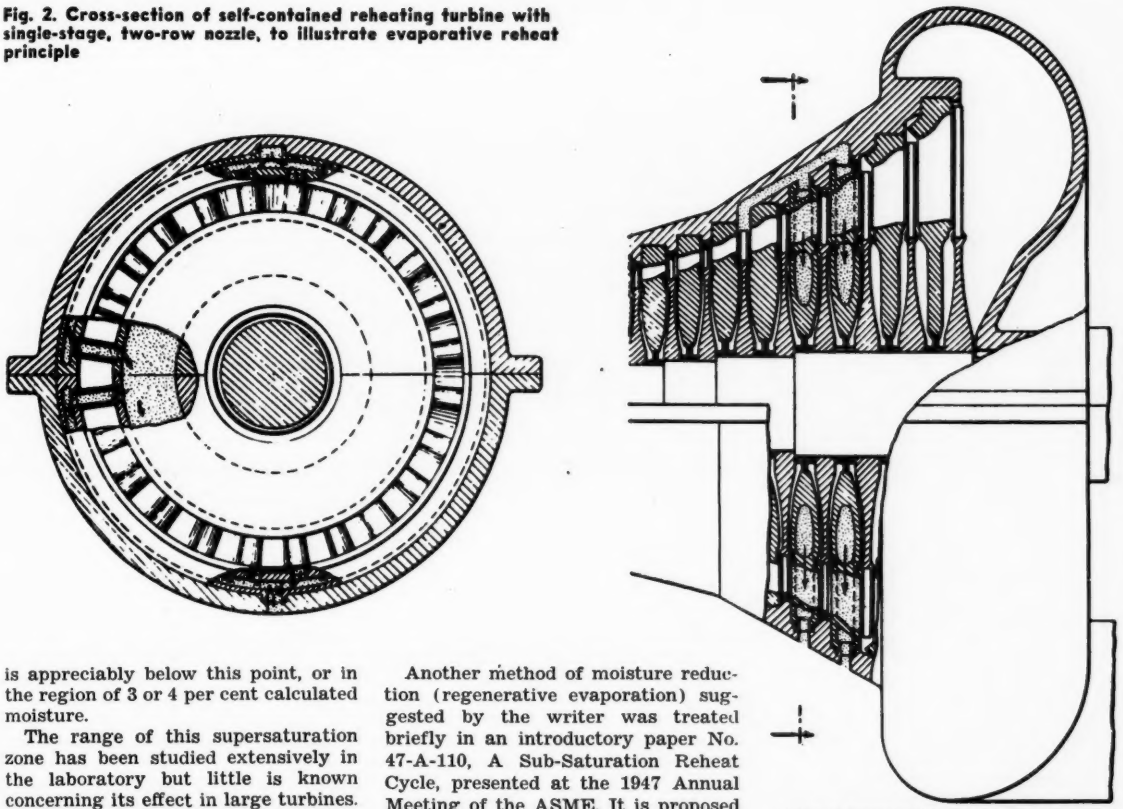
Aside from blade erosion by moisture, turbine casings, stationary blades and diaphragms also become eroded, especially at the seats where pressure differences exist. The dew point is usually assumed to occur at the intersection of the condition curve with the saturation line on a Mollier diagram, but the actual manifestation of the effects of water

Fig. 1. Typical moisture - eroded exhaust blades after 32,000 service hours; moisture 11 per cent. New blades installed in adjacent stage

TABLE 1—Kilowatt loss based on 1.15 per cent decrease in stage efficiency for each 1 per cent increase in moisture content from dry stage efficiency of 85 per cent. Steam conditions 1200 psi 950-F and 1 in. back pressure with 300,000 lb per hr exhaust flow.

Stage No.	Pressure Lb Abs	Moisture Per cent	Adiabatic Heat Drop Btu per lb	Kw Loss due to Moisture
13	34.5	2.1	26	47
14	24.0	3.8	27	88
15	16.0	5.2	27	120
16	10.5	6.5	31	174
17	6.8	8.0	33	227
18	3.9	9.6	34	280
19	2.2	11.0	37	350
20	1.1	12.2	41	430
				1716

Fig. 2. Cross-section of self-contained reheating turbine with single-stage, two-row nozzle, to illustrate evaporative reheat principle



is appreciably below this point, or in the region of 3 or 4 per cent calculated moisture.

The range of this supersaturation zone has been studied extensively in the laboratory but little is known concerning its effect in large turbines. It seems probable that, in the supersaturation zone, stage efficiencies would be approximately that of the superheat region. However, the stage in the turbine at which erosion patterns become conspicious establishes the boundry of the wet region, below which stationary parts are enveloped in a water film during operation.

While the maintenance problems with blades and other turbine parts due to water cutting is common knowledge, the associated loss in efficiency is not generally appreciated. The magnitude of this loss was indicated in a paper by Blowney and Warren in ASME *Transactions*, 1924—Vol 46. In accordance with analytical methods presented in this paper, Table I was prepared to indicate the loss of output in relation to moisture for a typical turbine. From the table it may be noted that the loss due to moisture is about 1700 kw for the turbine and conditions under consideration. This is about 8 per cent of the optput generated below the apparent dew point, which, for the existing initial conditions, occurs at about 35 psig, or about 4 per cent of the total output of the unit from 1200 psi initial pressure to 1 in. exhaust.

The greater part of the net gain in the usual reheat cycle is due to the recovery of part of this loss through the resulting moisture reduction. A substantial loss, not included above, results from lowered efficiency due to progressive blade surface deterioration by the continuous erosion process.

Another method of moisture reduction (regenerative evaporation) suggested by the writer was treated briefly in an introductory paper No. 47-A-110, A Sub-Saturation Reheat Cycle, presented at the 1947 Annual Meeting of the ASME. It is proposed to reheat with bleed steam in combination with hollow stationary blades or nozzle partitions. The surfaces of the nozzle blades are adequate and bleed steam may be obtained at the low pressure suited to the required temperature differences to yield the necessary heat transfer.

The elemental illustration of a modified low-pressure turbine, Fig. 2, indicates the passages required for reheating with bleed steam. Steam extracted from higher stages enters the top of the diaphragm passage, flows through the hollow blades to the center segment then into the lower halt

(Continued on page 110)

TABLE II—Kilowatt recovery by regenerative reheating based on 300,000 lb per hr exhaust flow to 1 in. back pressure with 1.15 per cent increase in stage efficiency for each 1 per cent reduction in moisture content up to 85 per cent dry stage efficiency at theoretical dew point

			Main Flow Steam		Heating Steam			Kw	Kw
Stage No.	Moisture Per Cent	Blade* Surface Sq ft	Press. lbs abs	Temp. Deg. F	Press. lbs abs	Temp. Deg. F	MTD -5 F	Gain Main Steam	Loss Heating Steam
15	5.2	66	16.0	218	60	293	80	274	81
16	6.5	75	10.5	195	50	281	81	290	95
17	8.0	97	6.8	176	24	238	57	210	82
18	9.6	146	3.9	152	16	218	61	250	124
19	11.0	192	2.2	130	6.8	176	41	88	50
20	12.2	342	1.1	105					

*Surface measurements taken from a typical 20-stage condensing turbine.

Stage No.	Condensate from Heating Blades lb per hr	Temp Deg F	Gain Btu 1000	Remaining Moisture Per Cent	Net Gain Kw
15	5500	288	1150	3.4	193
16	6200	276	1200	2.5	195
17	5600	233	860	2.1	128
18	8900	213	1190	0.7	126
19	4500	171	414	0.6	38
20	------	------	------	1.8	------
			4814		680†

†If dry stage efficiency prevails in supersaturation zone this gain may be increased about 350 kw.

Here is a description of the Contact Converter developed by Siemens-Schuckert in Berlin, Germany A brief description of this converter was given in the July, 1947 issue of Power Plant Engineering and reference to it was also included in "What's New in the Electrical Society, and his subsequent discussion before the A.I.E.F. last tion is given, based on Otto Jensen's paper before the Electrochemical Society, andhis subsequent discussion before the A.I.E.E. last January. The Contact Converter is a purely mechanical rectifier but as built in Germany during the war, is capable of rectifying currents as high as 10,000 amperes at 400 volts and with an efficiency of around 98 to 99 per cent.

A MECHANICAL RECTIFIER

THOSE familiar with the history of electric lighting know of the feud that existed between the adherents of direct current on the one side and the proponents of alternating current on the other in the early nineties. Edison had developed the direct current system and in the early years after the opening of Pearl street station this gained considerale headway. Then, George Westinghouse and his associates proposed the alternating current system and the fight was on, Westinghouse on one side and the General Electric on the other. In time, the alternating current system won and to this day has prevailed.

Curiously enough, however, no sooner had the use of alternating current become general, electrical engineers began their search for a device which would convert alternating current into direct current! While alternating current had many advantages it was apparent that certain operations, such as battery charging, electroplating, magnetic devices and other equipment still required direct current to function. The obvious solution was the use of motor generator sets but rotating machinery was not looked upon with favor for small units as noise and inefficiency tended to render rotating machines objectionable.

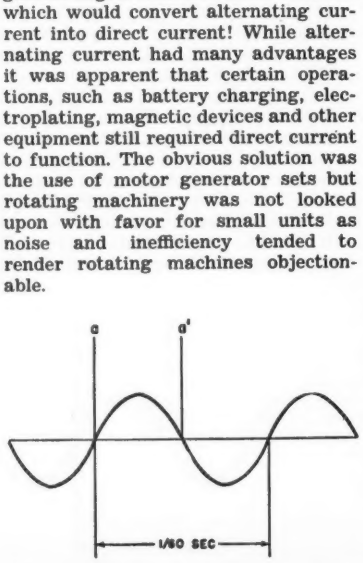


Fig. 1 Diagram of an alternating current wave showing points a and a' at which contacts of a mechanical rectifier would have to open and close

It was obvious that if an automatic switch could be built which would connect the a-c voltage to the load in such a way and at such a time that the current would flow through the load in one direction only, this would provide a satisfactory d-c supply for most purposes.

The idea was simple enough but the difficulty of designing a mechanically operated switch which would operate 60 times per second and always break and make the circuit at the exact time when the a-c wave was passing through zero proved an extremely difficult if not impossible problem. Fig. 1.

Various methods of building such rectifiers were developed, some extremely ingenious and complicated, but they soon divided into two major types, namely, vibratory switching and rotating switching.

At the same time, other methods of rectification were discovered, first the electrolytic rectifier and later the mercury-arc rectifier. The mercury-arc rectifier gained considerable headway because of its ability to handle large currents but efforts to build mechanical rectifiers persisted and in time some success was attained with this type in small units. The synchronous, rotating type also came into considerable use for the rectification of high voltage current used in connection with the Cottrell precipitator.

With further development of the mercury-arc, and thermionic tube rectifiers, however, little attention was given to the mechanical rectifier in this country and during the last twenty years it has been all but forgotten.

In Europe, particularly in Germany and to some extent in Switzerland, the idea of the mechanical rectifier persisted and a number of units developed. Little attention was paid to these German developments in this country, until the close of the war. Then, it was discovered that a synchronous mechanical rectifier developed by Siemens-Schuckert in Berlin had proved extremely successful and a boon to German electrochemical industries requiring large amounts of direct current at low voltages. This, "contact rectifier[1] it was claimed attained efficiencies as high as 99 per cent.

The I. G. Farbenindustrie, Germany's omnipotent chemical cartel, installed various models in its branch factories. Its Heydebreck branch, for example, contained four rectifiers, each capable of supplying 8000 amp at 400 v and its Bitterfield branch had two rectifiers, each rated at 9000 amp for 90 to 180 v.

In 1943, the Siemens-Schukert Co built a model capable of delivering 10,000 amp at 400 v, or 5000 amp at 800 v, and by the end of the war had designed rectifiers with outputs of 60,000 kw!

Now, capacities of this order cannot be discounted under any conditions and when they are associated with efficiencies of 98 and 99 per cent, the merits of these mechanical rectifiers are well worth investigating.

[1] "Contact Rectifiers", Power Plant Engineering, July 1947, page 107.

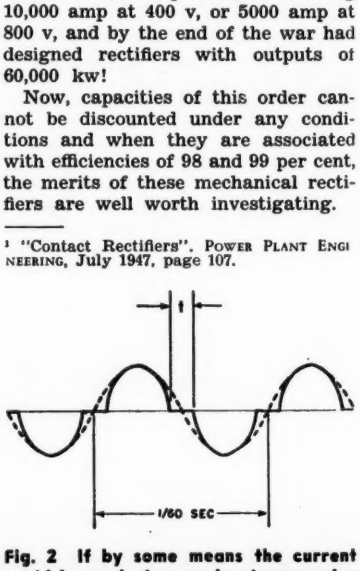


Fig. 2 If by some means the current could be made to remain at zero value for an appreciable interval between reversals, there would be ample time for a set of contacts to open and close

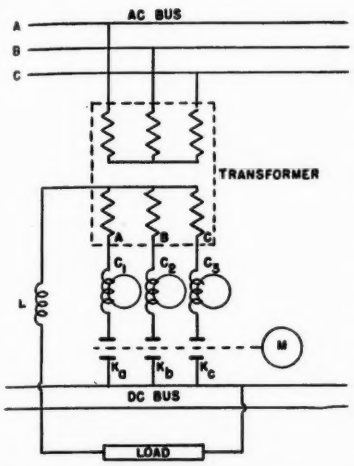


Fig. 3 Schematic diagram of a contact rectifier

Immediately after V-E day an American commission went into Germany to study the technical development made there during the war and among other things found these mechanical rectifiers. Otto Jensen of the I.T.E. Circuit Breaker was a member of this commission and he immediately recognized the merits of these devices and after a second trip to Germany managed to bring one of the 10,000 amp units back to the United States and set it up in the I.T.E. Circuit Breaker factory in Philadelphia. There, under his direction, the design and operation of the device was studied and development started on a line of American made units incorporating a number of improvements over the German units. This work has proved very successful and even before the development was out of the experimental stage, orders for large units were received from American industries.

As already indicated the principal difficulty in producing a mechanical rectifier is in devising a means whereby the contacts open and close at the exact instant that the a-c wave passes through zero. Since this is the point on the wave where the rate of change in current is greatest, the time available for the contacts to act is extremely small—a matter of microseconds. With the inevitable changes in load of commercial circuits, even if it were possible to build a rectifier which would operate in such short time intervals it would be impossible to attain any degree of stable operation.

Suppose, however, that by some means it were possible to alter the wave form of the a-c voltage so that the voltage remained at zero for an appreciable length of time between alternations, as shown in Fig. 2. Then, there would be a time interval, during which the rectifier contacts could open and close, and since there would be no current in the circuit during this interval, there would be no arcing of the contacts.

This, actually, is the principle used in the German rectifier. By means of a special type of reactor, the wave shape of the alternating current is altered so that the voltage remains at zero for an appreciable length of time and this gives the contacts time to open and close.

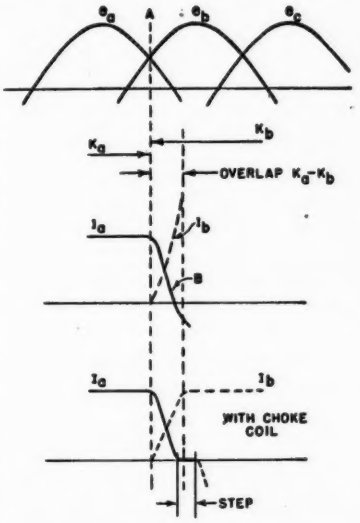


Fig. 5 Commutation current curves

The reactor is known as a commutating reactor. This reactor is of the saturating type and offers very little impedance to any change in current so long as it is saturated (when the current is high) but when not saturated, it opposes any sudden change.

If a reactor of this type is connected in the rectifier circuit, it will be evident that it will have no effect on the wave shape when the voltage is at the top of the wave but as the voltage approaches zero, and the reactor *desaturates*, it offers impedance to further change and the current, therefore stays at zero value while the flux direction in the reactor is being reversed.

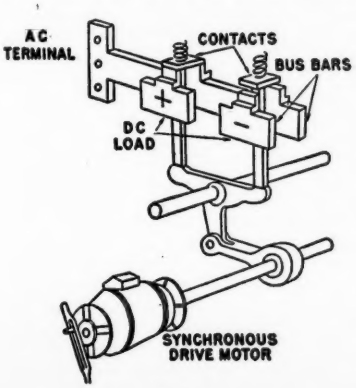


Fig. 4 Contact drive

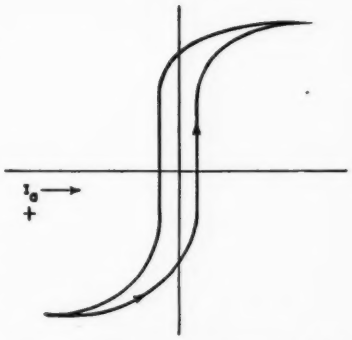


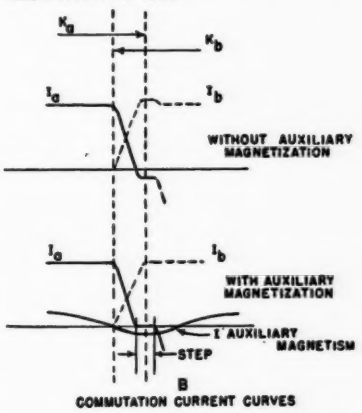
Fig. 6 Magnetization curve of choke coil iron core

It is because of this type of commutating reactor that the German "Contact" rectifier *works*. Knowing this basic principle let us study the mechanism and its operation in further detail.

Basic Principle[2]

The contact converter consists of a contact mechanism synchronously driven and adjusted to make metallic contact between the a-c source and the d-c load at proper time intervals, that is, when the particular phase of the a-c system is capable of delivering energy in the desired direction. A schematic diagram of the contact

[2] The following description of the operation and construction of the contact converter is taken from a paper entitled "A Mechanical Rectifier" presented by Otto Jensen of the I.T.E. Circuit Breaker Co., before the Electrochemical Society, at Toronto, Canada, October 17, 1946.



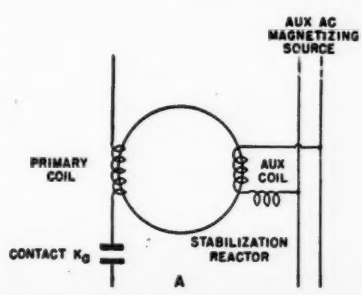


Fig. 7 Schematic auxiliary magnetization of choke coil

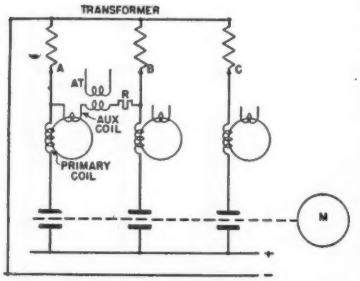


Fig. 8 Diagram of auxiliary magnetizing of choke coils

converter is shown in Fig. 3. The contact drive is shown in Fig. 4. The three secondary transformer terminals are connected through a saturating reactor or choke coil to three contacts connected to the positive bus; the star point of the secondary winding is connected through a load reactor to the negative bus. The contacts are driven by means of the synchronous motor "M".

The commutation circuit is illustrated in Fig. 5. If for the time being we disregard the three choke coils, C_1, C_2, C_3 and consider point "A" where the voltage curves e_a and e_b intersect, K_a should be opened and contact K_b should be closed. The current I_a flowing through contact K_a will however not die down instantaneously but will decay at a rate determined by the inductance in the circuit. Therefore, contact K_a would interrupt current if it were allowed to open at point "A" and would be destroyed in a very short time.

If contact K_a is permitted to stay closed and contact K_b is closed to point "A", then a short circuit current I_b will flow from transformer terminal "B" through contact K_b and contact K_a to transfer terminal "A". The rate of rise of this short circuit current is determined by the inductance of the circuit and the voltage difference $e_b - e_a$. When the decaying current I_a has reached zero at point "B" (Fig. 5), it would be permissible to open up contact K_a because now current I_b has reached the value of I_a and is capable of taking over the duty of delivering load current.

Point "B" is not definitely located as its location on the zero line depends upon the inductance of the circuit, current I_a and the a-c voltage. Furthermore, the rate of change of the current as it passes through zero is very steep, and it would be difficult to design a contact mechanism to open at sufficient speed to catch the absolute zero current point.

Now consider the three reactors C_1, C_2, and C_3 inserted in their respective circuits. The reactors are of the saturating type and offer very little impedance to any current change as long as they are saturated, but in a de-saturated condition they oppose any sudden current changes. Current I_a will now decay at approximately the same rate it would have decayed at before inserting the choke coils. But when the current approaches zero, the choke coil will offer resistance to further change and the current will therefore stay at the zero value while the flux direction in the choke coil core is being reversed, causing a prolonged zero current, or step. Contact K_a can now safely be opened at any time during the duration of the step.

The choke coil iron must have a sharp magnetizing knee as shown in Fig. 6. A 4 per cent silicon iron or nickel-iron has been used.

Auxiliary Magnetization of Choke Coil

Figure 6 indicates that the decaying current I_a, the current would have to go through zero and reach a small negative value before any sudden flux change can take place in the iron core. This condition is indicated in Fig. 7-A where current I_a crosses the zero line before the hesitation step is obtained. For contact K_a to break even this small amount of current would be detrimental and therefore provision must be made to assure that the hesitation step occurs along the zero current line.

Figure 7-A shows an auxiliary coil on the choke coil iron core. This coil is fed from auxiliary a-c magnetizing source through a stabilizing current. This effect is shown in Fig 7-B where current I_a decays until the true zero line has been reached where it then hesitates before reversing and the $I_{AUX.\,MAG.}$ is furnishing the necessary negative current.

Figure 8 shows a method of energizing the auxiliary windings of the choke coil. This coil is connected across terminals A and B and the voltage difference $e_b - e_a$ is therefore applied across the auxiliary coil. In order to make up for the ohmic resistance of the auxiliary coil, a small transformer AT is inserted in the circuit. A resistor R limits the current flow through the auxiliary coil after saturation of the choke coil core occurs.

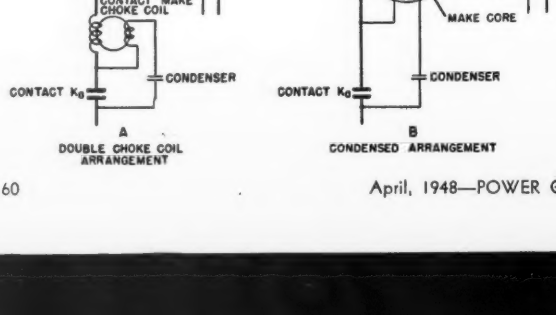


Fig. 9 Contact "make" choke coil arrangement

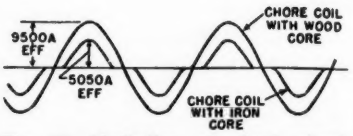


Fig. 10 Limitation of short circuit current by means of choke coil

Up to now we have supposed that contact K_b could be closed without taking any precaution to prevent arcing. This would be true if the contact were always closed precisely at the correct point "A". It is desirable to delay the contact closing for an appreciable time in order to obtain

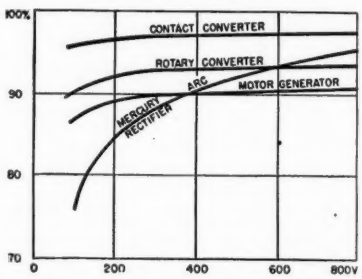


Fig. 11 Comparison of efficiency as function of voltage

voltage regulation of the contact converter. Under these circumstances the contact is required to close against an appreciable voltage and consequent current. Inasmuch as the contact surface cannot be made to contact over the full area instantaneously, the first points to make contact would have to carry the load; thereby becoming incandescent and starting an arc. This arc would disappear when sufficent contact area is engaged to carry the load current without overheating. On separation of contact it would then be found that the original contact points are welded together and would have to be torn apart by the force of the operating mechanism. This would cause a contact crater and a corresponding pyramid. The contact would therefore be destroyed in a very short time by this action and also by actual loss of contact material due to evaporation.

To overcome this difficulty a contact making choke coil is utilized as shown in Fig. 9A. A secondary coil on the iron core of this choke coil is energized by the discharge of the condenser when contact K_a is made, thereby opposing the build-up of the load current. This choke coil is considerably smaller than the contact breaking choke as the hesitation period does not have to be very long.

In order to save material, the ar

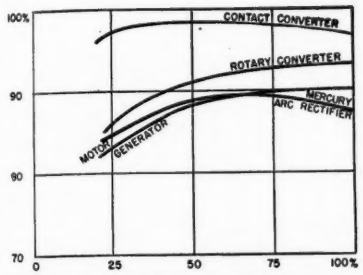


Fig. 12 Comparison of efficiency as a function of load current

rangement of the two choke coils can be made as shown in Fig. 9-B where one common primary winding is wound around the two iron cores, each of which in turn is equipped with its own auxiliary coil.

Mechanical Construction

The construction of the contact mechanism depends upon the rating of the contact converter. This description is limited to the contact mechanisms used in the 5000 and 10,000 amp machines. Fig. 4 shows schematically the arrangement of single phase contact. An eccentric mounted on a synchronously driven shaft "A" operates a rocker arm pivoted on shaft "B" Two push rods lift either the positive or the negative contact against the closing action of the contact springs. The moving contacts are approximately 1.25 in. square (32 mm x 32 mm) and all contact surfaces are silver inlaid. The rocker arm is not directly pivoted on shaft "A" but on an eccentric fastened to shaft "B" By turning shaft "B" the pivot point of the rocker arm is raised or lowered and consequently the time at which the contacts are opened or closed is adjusted.

All the moving parts except the contacts and the upper portion of the push rods are enclosed in a carefully machined housing. All points where there is rotating friction are equipped with ball bearings or needle bearings. Forced feed lubrication is provided and the mechanical housing is equipped with an air filter to assure exclusion of dust particles or other foreign matter. The lubricating oil is cooled in a conventional type oil cooler. The complete contact drive mechanism was designed by an airplane motor engineer and has given no trouble.

The a-c and d-c bus bars are water cooled and a small water-to-water or water-to-air heat exchanger is used for keeping the water in the closed system cool.

For simplicity's sake Fig. 3 shows a star connected arrangement; actually the converter is built to utilize both the positive and negative half-cycle. The 5000 amp machine utilized one main transformer and 6 contacts, resulting in a 6-phase secondary system. The 10,000 amp machine utilized two main transformers, the primaries of which are connected, one in star and the other in delta, giving a 6-phase primary effect. It is equipped with 12 contacts driven by a common synchronous motor, resulting in a 12-phase secondary system.

Overload

The overload capacity of the contact converter is limited to the extent where the time for the decay of current I_a is the same as the overlapping of contact K_a - K_b. If the current rises above this value, it will not have reached zero current value when contact K_a opens up and an arc will therefore occur.

In order to protect the contact converter against any arcing on the contacts caused by overload, short circuit, or synchronous motor falling out of step when very rapid frequency changes occur, the converter is equipped with a short circulating device inserted between the choke coil and the contacts. This device short circuits all the contacts in 1.1 milliseconds and therefore protects all the contacts except the one on which the arc started. The damage done to this contact is so small that the rectifier can be re-started immediately.

By inserting the short circuiting device between the choke coils and the contacts, the short circuiting current is materially limited because the choke coils still cause a current zero step and therefore cut down the time in which the a-c current will build up. This condition is shown in Fig. 10 which shows two oscillograms superimposed on each other, one with no reactors in the circuit and the other with reactors.

If the converter is connected to a system capable of feeding reverse direct current into the short circuit, this current must be interrupted by means of a high speed breaker in the positive lead.

The efficiency of the contact converter is very high as compared with rotary converters or mercury arc rectifiers. This is particularly true in the lower voltage range where the proportion of the arc drop in the mercury arc rectifier is considerable.

ENERGY LOSSES FOR 500 VOLT, 5000 AMPERE EQUIPMENT

	Rotary Converter	Contact Converter	
Iron	15 kw	2 kw	
Regulation	10	-----	No Load Losses
Brush Friction	15	-----	No Load Losses
Wind and Bearing	20	3	No Load Losses
Heating in Armature	19	15 Choke Coils	No Load Losses
Heating Interpoles	5	----	Load Losses
Brush Voltage Drop	15	5	Load Losses
Auxiliaries	16	----	Load Losses
	115	25	
Efficiency	95.4%	99%	

Figure 11 compares the efficiencies of a contact converter with a rotary converter, a motor generator set and a mercury arc rectifier as the function of the d-c voltage. Fig. 12 indicates the efficiency of the same machine as the function of the load with a voltage output of each machine of 300 volts. In all cases the efficiency is given as the overall efficiency and includes transformer losses or motor losses as the case may be.

Figure 13 shows a comparison of the weights of iron and copper required for a rotary converter, a motor generator set and a contact converter. Fig 13 also shows the per cent energy losses for the three machines.

The accompanying tabulation compares the various losses of a rotary converter and a contact converter.

The German operating experience indicates the reliability of the contact converter. In the chlorine plant at the I. G. Farben factory at Ludwigshafen, the contact converter has been in continuous operation since 1940. During this time the short circuit safety device operated but twice and the contact life was in the neighborhood of two months per set of silver contacts. Perhaps some other American contact material could further improve the contact life. The overall efficiency of 97 to 98 per cent at the relatively low voltage used in an electrochemical plant should make it attractive to the American electrochemical industry. The small space requirements and low maintenance costs also are desirable.

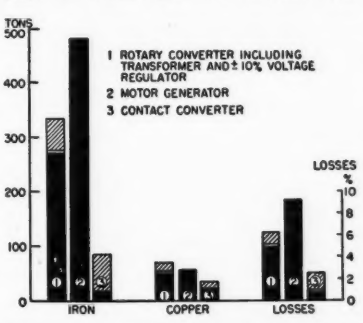


Fig. 13 Comparison of material weight and of energy losses. Conversion losses for a 30,000 kw-300v conversion station. The black areas represent converter equipment. The shaded areas represent transformer equipment

How to Make Industrial Steam Plants Pay With Today's High Costs

Engineers can help reduce costs of production by directing economic analysis of their power plants . . . Specific examples of analysis to show how it may be done . . . Executive must see that power plant services are obtained reliably with minimum capital cost and maximum over-all return . . . Per cent return test . . . Operator responsible for adequate and economical service . . . How to figure costs of shutdowns, of operation and maintenance, of modernization . . . Power Plant Performance Standards System leads to fuel reductions of 10 to 15 per cent . . . Effect of equipment component costs on over-all costs . . . Designer must aim for minimum investment, minimum operating costs, adequate service without shutdown . . . Standardized investment cost classifications

By **BYRON A. LININGER,** Power Consultant, Engineering Dept., E. I. du Pont de Nemours & Co.

CONSTRUCTION COSTS are at an all-time high and there is much pressure to reduce the selling price of manufactured goods. Consequently, facilities purchased at today's high price will become a financial burden when income from use of these facilities declines. Engineers can be a vital influence in directing the economics of this problem so that future industrial economic conditions will be healthy.

"Economics" is thrifty management of venture capital. Thrifty management implies operating cost reductions to result in increased profit. Venture capital is the increased investment required to make possible increased profit. The ratio of these two factors is per cent return.

$$\% \text{ Return} = \frac{\text{Increased Profit}}{\text{Increased Investment}}$$

This is the per cent return test; it is the key to economic analysis. When this test is applied to a proposal and the result meets minimum requirements, the proposal is considered to be "justified" financially. The terms "Justified" and "Acceptable Return" used hereafter are meant to be synonymous.

Economics is a matter of concern to all engineers. Different viewpoints, however, seem to conflict. This subject was discussed as follows, before the 1947 Semi-Annual ASME meeting, in a paper entitled The Economics of Industrial Steam Plants. It was treated from the viewpoint of:

1. *The Executive* whose principal responsibility is the success of an enterprise.
2. *The Plant Operator or Supervisor* whose principal responsibility is to provide adequate and economical service.
3. *The Designer* whose principal responsibility is to provide designs which will result in low investments, low operating costs and adequate service.

The Executive's Viewpoint

It is assumed that steam is required to provide heat for comfort and process and energy to drive the machinery. The executive requires that this facility be provided at a minimum capital cost, imposing no unnecessary operating cost burden that will interfere with high over-all return.

Shall the steam generating plant be provided by industry, or shall steam be purchased? Public utility steam electric generating plants, located adjacent to industrial steam and electric power consuming plants, offer attractive economic opportunities to the public utility and to industrial enterprise where load conditions and long-time contractural relations are favorable.

A reasonable agreement for supply of steam and electric power by a utility would require the cooperating industrial customer to pay certain fixed and certain variable operating charges plus fixed charges on total allocated capital. These capital charges would include a return on investment in addition to depreciation, and would be payable regardless of the load placed on the utility system by the customer.

Table I shows operating cost and investment data for these alternate sources of heat energy.

Scheme I in Table I shows costs to industry when facilities are provided by a public utility. Scheme II shows costs if the same facilities are provided by private industry. It is assumed that there is no difference in investment, and that operating costs will be the same for each scheme.

Table 1. Economic analysis owned and operated facilities vs. purchased steam.

Scheme	I	II
Ownership	Public Utility	Private Industry
Investment		
Fixed	$7,210,000	$7,210,000
Working Capital	693,000	693,000
Total	$7,903,000	$7,903,000
Operating Cost to Industry $/Year		
Fuel	$1,811,466	$1,811,466
Operating Labor	160,550	160,550
Maintenance and Up-Keep	191,937	191,937
Supplies and Misc. Charges	51,321	51,321
Superintendence	26,813	26,813
Taxes and Insurance	89,825	89,825
Sub-Total	$2,331,912	$2,331,912
Fixed Charge on Working Capital	41,580	
Fixed Charge on Perm. Inv.	756,308	316,128
Total Annual Cost	$3,129,800	$2,648,040
Gross Cost Reduction		481,760
Less for Taxes, etc.		192,700
Net Cost Reduction		$ 289,060
Return on Investment		$ 289,060
% Return on Gross Capital		3.6%

The significant change occurs in capital charges. The example indicates clearly that annual operating cost will be less if private industry invests in the steam plant, but the executive looks further. The operating cost reduction to industry yields only a 3.6 per cent return on required gross capital. The industrial executive must decide if this rate of return will justify the investment.

Rates of return required for an industrial venture should be higher than those acceptable in the money markets because there is no guarantee of repayment to the lenders. The risk is much greater. The executive, therefore, decides what rate of return is acceptable. This rate may vary. Some contend that high return rates are more applicable to short life process equipment than to long life steam plants, but the executive cannot accept this contention because he knows that the stockholder's income is dependent on the output of the process. When the process goes out of business, the entire plant investment yields zero return.

The example shown is a case for public utility steam supply. The utilities' financial picture appears satisfactory, since certain affected costs and fixed charges on allocated capital are guaranteed. A higher over-all turnover and profit is possible for the cooperating customer. Several such arrangements are in existence.

Mutual exploitation of these possibilities for increased profit is a challenge to industry and to public utilities.

There are cases where such joint venture is not practical because of physical conditions. Therefore, this discussion will continue with the thought that industry will make a capital investment in steam plant facilities.

When Is Minimum Investment Not the Thing?

The executive sometimes takes a view seemingly opposite to the original premise of minimum investment. Extra investment for attractive buildings and pleasant working conditions may be required. These conditions may be desired to attract labor and maintain good labor relations, community good will, or to be a part in the over-all advertising plan. Such factors can be given economic values reflecting their effect on increased earnings just as thrift or cost reduction affect these earnings. Here again the executive establishes the minimum return for such investment and applies the per cent return test.

The remainder of this discussion will be concerned with the low first cost and low operating cost hypothesis.

The Operator's Viewpoint

The operator, in this discusion, is the manager or supervisor of the steam plant facility, responsible for an adequate and economical service.

Maintaining an adequate service means a supply of power at all times. Shutdowns due to failure of power supply have definite monetary values. The good operator places a dollar value on plant failures of various types and duration. These monetary values are the numerator in the equation which determines return on investment made to prevent such failures.

Maintaining an economical service requires study of power utilization, study of operating and maintenance methods, use of new materials of construction, and modernization of equipment.

Power conservation is an operating function, which is necessary if investment in power facilities is to be kept low. Economies in power utilization have permitted increased production without adding power facilities, thus increasing return on the total investment. This is thrifty management of venture capital by the operator.

Cost of Operating Method Changes

Operating method changes have resulted in important cost reductions requiring little capital investment. This type of change requires engineering skill. Application of the Power Plant Performance Standards System is an example. This system provides a measure of over-all station performance. The standards system permits determining minimum fuel input for any given station output. The ratio of standard to actual fuel consumption is the over-all station perform-

(Continued on page 134)

Table II. Economic analysis of a steam plant modernization project

	Existing	Proposed
Boiler Capacity Lb./Hr.	50,000	60,000
Type of Furnace	Refractory	Water Cooled
Type of Fuel	Coal	Coal
Type of Firing	Pulver Coal	Spreader Stoker
Operating Costs		
Fuel	$113,091	$ 91,446
Maintenance	9,150	6,480
Operating Labor	44,380	33,070
Purch. Electricity	3,000	1,200
Inv. Charges (Additional)		3,484
Total	$169,621	$135,680
Gross Reduction Proposed		$ 33,941
Less for Taxes, etc.		13,141
Net Cost Reduction		$ 20,800
Investment		$ 95,600
Net Return		21.8%

Table III. Economic analysis of motor drive versus turbine drive for forced-draft and induced-draft fans

Type of Drive	Motor	Turbine
Investment	$2,639	$6,242
Annual Operating Cost $		
Electric Power	190	
Heat Consumed	....	30
Operating Labor	....	
Maintenance	35	200
Process Interruption Cost	2,000	....
Depreciation at 6%	158	375
Total Operating Cost	$2,383	$ 605
Gross Cost Reduction		1,778
Less for Taxes, etc.		687
Net Cost Reduction		$1,091
Differential Investment		$3,603
% Net Return		30.3%

Table IV. Economic analysis of steel chimney versus concrete chimney

Plan	A	B
Type of Chimney	Steel	Concrete
Initial Investment		
Chimney	$ 5,000	$12,000
Foundation	500	2,000
Total	$ 5,500	$14,000
Probable Life	15 yrs.	30 yrs.
Replacement Expense during 30 Yrs.	$11,000	None
Annual Operating Cost		
Replacement	$ 360	$ ....
Painting & Inspection	500	200
Depreciation at 6%	330	840
Total	$ 1,190	$ 1,040
Gross Saving due to Concrete Chimney		150
Less for Tax, etc.		$ 60
Net Annual Saving		$ 90
Additional Investment Required		8,500
% Return		1%

How to Construct Overfire Jets

Follow these instructions and build your own overfire jets, mostly from standard pipe fittings... Not a substitue for poor firing mehods... Steam jet alone to produce turbulence ... How to design and build blower-jet and steam-air jet ... Heating value of fuel affects air required ... How to find correct air tube size ... How to construct silencer or muffler to decrease jet noise

OVERFIRE AIR, as the name implies, is air for combustion supplied to the furnace above the fuel bed, not through it. Usually this is accomplished by means of a series of nozzles or jets evenly spaced across the furnace width introducing air above the fuel bed.

Today, the overfire air is supplied by steam-air jets or blower-air jets that are individually engineered on known or calculated performance for each installation.

Methods of locating jets in the different types of furnaces were detailed in Where to Put Overfire Jets, by William S. Major, March, 1948, page 95. Below are given detailed data for building the jets.

Overfire air jets should not be used to compensate for poor firing practice. They should be installed only when it has been definitely demonstrated that there is no other way to stop smoke and soot.

Where it has been determined that jets will reduce smoke and soot or improve efficiency it will be necessary to decide which type of jet should be used. Following data* on their construction are based on BCR Technical Report No. VII.

The steam jet, alone, will often suffice where turbulence of the fire without increasing the excess air is all that is required. If some air is required and the operation will be intermittent then the steam-air jet may be the best for the job. Where a greater percentage of air is permissible and low operating cost is important the blower jet will most likely be the correct answer. There are, therefore, three types of jets, each particularly suited to certain conditions. Before anything can be done toward designing jets for any particular installation it is necessary that the problem be analyzed by determining the maximum burning rate per sq ft per hr, the percentage of overfire air required, the penetration necessary to reach the spot needing turbulence, and the heating value of the coal. In connection with the heating value of the coal it will also help to know the percentages of volatile and fixed carbon matter.

The maximum burning rate should be first determined by observing the hourly rate of coal consumption under a peak load, and dividing this amount by the grate area in sq ft.

The amount of overfire air, as a percentage of the theoretical air required should be assumed. Light smoke will indicate 10 per cent overfire air required; moderate smoke, 20 per cent; heavy smoke, 30 per cent.

Penetration of the jet into the furnace will vary according to the stoker and furnace design, and the pressure of the jet. In some cases it is only necessary to reach part of the fire, as with the single retort underfeed stoker, where it is only necessary to reach just beyond the full length of the retort.

It is necessary to obtain an anlysis of the coal because the Btu per lb

*For additional information regarding design of overfire air jets the reader is referred to Technical Report No. VII, by Richard B. Engdahl and Wm. S. Major; obtainable from Bituminous Coal Research, Inc., 912 Oliver Bldg., Pittsburgh, Pa., price 25 cents.

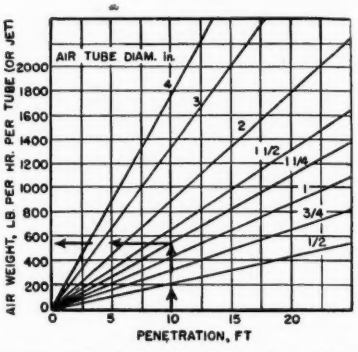


Fig 2. Calculation chart for air weight per tube

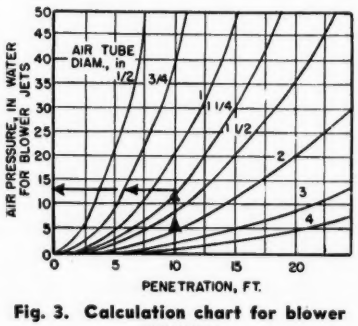


Fig. 3. Calculation chart for blower pressure

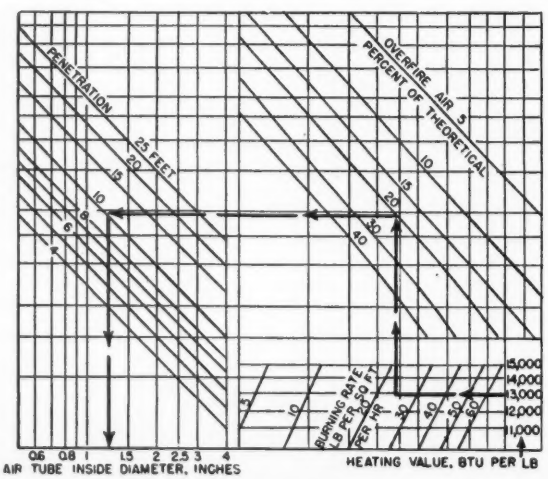


Fig.1. Chart for calculation of air tube diameter

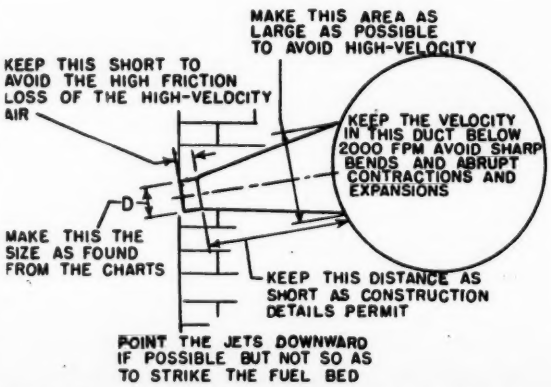

MAKE THIS AREA AS LARGE AS POSSIBLE TO AVOID HIGH-VELOCITY
KEEP THIS SHORT TO AVOID THE HIGH FRICTION LOSS OF THE HIGH-VELOCITY AIR
KEEP THE VELOCITY IN THIS DUCT BELOW 2000 FPM AVOID SHARP BENDS AND ABRUPT CONTRACTIONS AND EXPANSIONS
D
MAKE THIS THE SIZE AS FOUND FROM THE CHARTS
KEEP THIS DISTANCE AS SHORT AS CONSTRUCTION DETAILS PERMIT
POINT THE JETS DOWNWARD IF POSSIBLE BUT NOT SO AS TO STRIKE THE FUEL BED

Fig. 4. Cross-section of a blower jet showing essential construction details

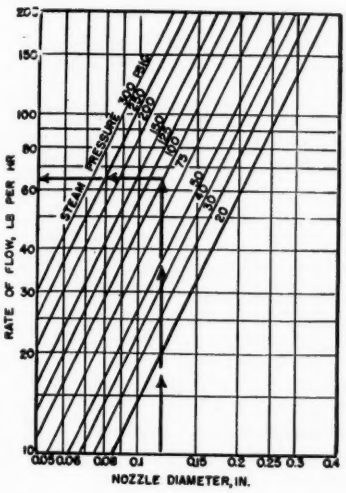


Fig. 5. Right. Steam nozzle selection chart

Fig. 6. Left. Flow of saturated steam according to Grashofs equation. Atmospheric discharge

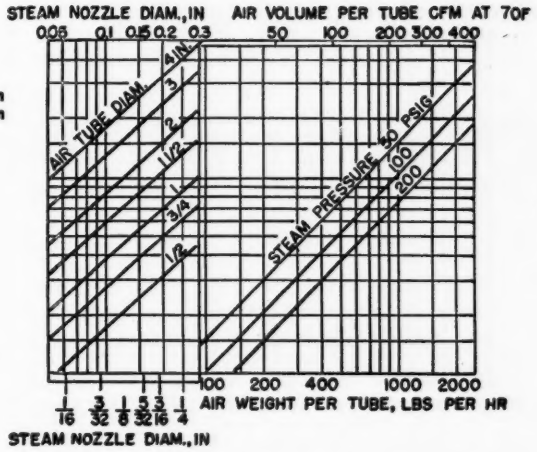


Table showing Recommended Centerline Spacing of Air Tubes
(To Nearest Inch)

Penetration Length, Feet	Air Tube Diameter, Inches					
	0.5	1	1.5	2	3	4
4	5	5	6	7	8	9
6	7	7	8	9	10	11
8	10	10	11	12	13	14
10	12	12	13	14	15	16
12	15	15	16	17	18	19
14	17	17	18	19	20	21
16	19	19	20	21	22	23
18	22	22	23	24	25	26
20	24	24	25	26	27	28
25	30	30	31	32	33	34

has a definite relation to the amount of air required. It is also of value to know the other qualities of the coal so the jets may be placed and aired properly. The company supplying the coal will be able to furnish this analysis.

Use the values for the heating value of the coal, burning rate per sq ft, per cent of overfire air, and penetration, on the chart in Fig. 1. This will give the air tube diameter in inches. Use the nearest standard size of pipe for this.

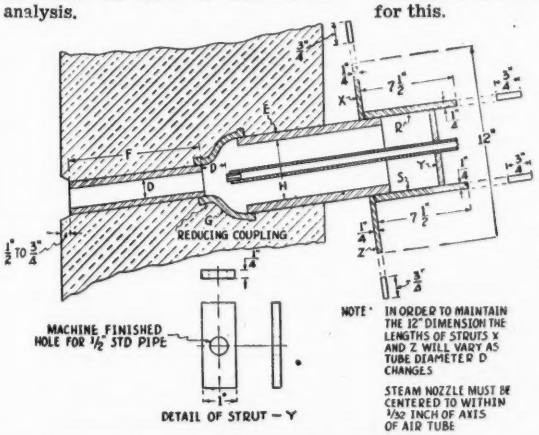

REDUCING COUPLING
MACHINE FINISHED HOLE FOR 1/2" STD PIPE
DETAIL OF STRUT — Y
NOTE: IN ORDER TO MAINTAIN THE 12" DIMENSION THE LENGTHS OF STRUTS X AND Z WILL VARY AS TUBE DIAMETER D CHANGES
STEAM NOZZLE MUST BE CENTERED TO WITHIN 1/32 INCH OF AXIS OF AIR TUBE

Fig. 8. Proportions of popular sizes of steam-air jets including means for supporting silencer

D	F	G	H	E
1"	5" to 10"	2½" x 1"	2½"	Length will vary depending on wall thickness and length F — With thin furnace walls it may not be required
1¼"	6½ to 12½"	3" x 1¼"	3"	
1½"	7½ to 15"	4" x 1½"	4"	
2"	10" to 20"	4" x 2"	4"	

Below is a table stating recommended centerline spacing for tubes.

The number of jets required is determined by dividing the inside length of the furnace wall in inches by the distance of recommended spacing in inches and subtracting 1. This is with the jets in the front wall. Locate the end jets one jet space from the side walls and space the others equally between.

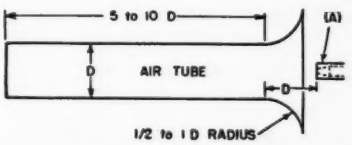


Fig. 7. Essential proportions of ideal steam-air jet

(A) Steam nozzle must be centered to within 1/32 in. of axis of air tube

The blower pressure required can be found by use of the chart in Fig. 3. Select the penetration needed, run a line vertically to intersect the air tube dia, then run a line horizontally to find the air pressure needed. If the resistance of the ducts is low this

(Continued on page 114)

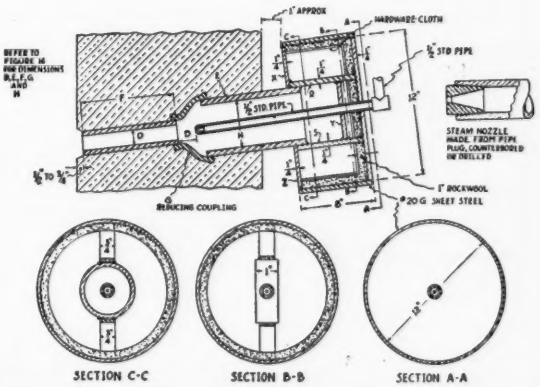


Fig. 9. Construction of steam-air jet with silencer. If air tube spacing is close, you can reduce silencer diameter to 8 in. but with more noise

Standard Builds 1250-psi Topping Plant for Whiting Refinery - I

Stanolind Station No 3, new 1250-psi, 900-F power plant, tops two existing 400-psi plants, generates 20,000 kw of electricity 900,000 lb. of steam . . . Ultimate expansion to 50,000 kw, 1,800,000 lb. steam per hour . . . Latest of small number of 1250 psi industrial power plants . . . Necessity for 100 per cent feedwater make-up leads to special provisions for water treatment . . . Dual circulation boiler design, to reduce blow-down losses and maintenance . . . Two initial back-pressure 10,000-kw turbine generators furnish exhaust at 400-psi, 650-F to processes, in parallel with existing 400-psi plants, reducing to 100 psi and 10 psi for other process distribution systems . . . To adjust steam and power balance and provide for future expansion, pressure reducing and desuperheating stations co-ordinate operation of four steam pressure systems . . . Topping turbines controlled by load limiting device . . . Fuels are oil and refinery gas, with design provisionsf or future pulverized coal . . . This article gives general description of plant; Parts II and III will cover boilers and feedwater treatment

By **D. A. MONRO**, Chief Engineer, and **A. T. MILBROOK**, Asst. Chief Engineer, Whiting Refinery
Standard Oil Co. (Indiana)

STANDARD OIL CO. (INDIANA) installed at its Whiting, Indiana refinery in 1928 a 440-psi 650F steam power plant, with turbine generators exhausting at 100 psi at 450 F to refinery steam power units and processes. This was one of the earliest high-pressure industrial by-product power generating plants. The refinery steam demanded at that time could produce surplus by-product electric power. But the trend in refinery operation was toward greater use of motor drives; furthermore, changes in refinery processes were reducing the demand for process steam. As a result, it eventually appeared that the existing back-pressure cycle would not produce enough power to supply the ultimate demand. Accordingly shortly before this country entered World War II, expansion in power generating facilities was imperative.

Engineering studies showed that in a 400-psi condensing cycle, 11 lb of steam per kilowatt would have to be produced for power generation alone, with about a 70 per cent condenser loss, and in addition to refinery steam. In a topping cycle, operating at 1250 psi and exhausting to the 400 psi system, which would in turn supply steam for the 100-psi and 10-psi systems, a total of 75 kw would be produced per 1000 lb of steam generated.

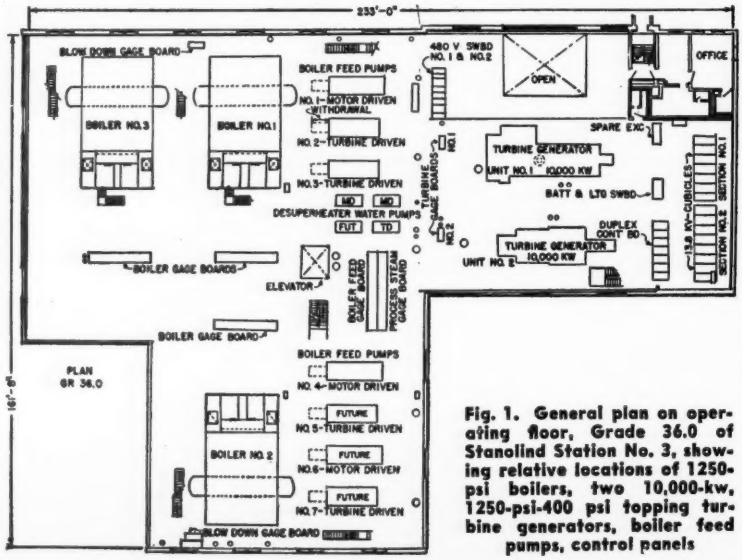
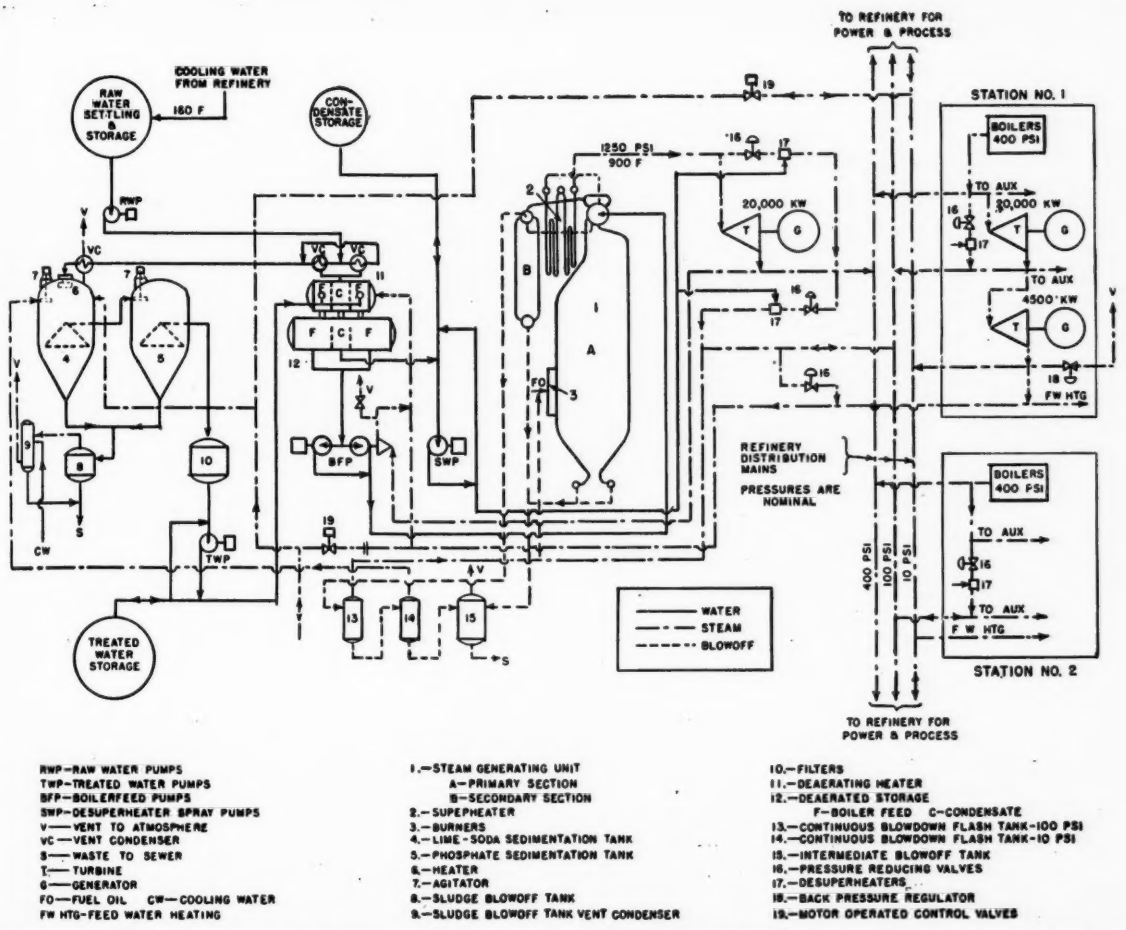


Fig. 1. General plan on operating floor, Grade 36.0 of Stanolind Station No. 3, showing relative locations of 1250-psi boilers, two 10,000-kw, 1250-psi-400 psi topping turbine generators, boiler feed pumps, control panels

In such a topping cycle, foremost problem was operation of high-pressure boilers with 100 per cent treated feedwater makeup, because condensate returns from the refinery were small in amount, likely to be contaminated, so widely distributed that collection was not economical. The company, however, in its various refineries, had had previous experience with Lake Michigan, Mississippi or Missouri River water, previously used as process unit cooling water, as boiler feed at pressures up to 600 psi. This water was available at Whiting in sufficient quantities, at temperatures from 120 to 180 F, to make its return and chemical treatment very attractive. Engineering studies showed this procedure might be feasible, but the outbreak of the war pigeonholed the project.

The refinery expansion during the war made it necessary to construct a steam generating plant with a total capacity of 1,000,000 lb per hr at 400 psi. To treat the feedwater for this plant, a two-stage hot-process water treatment system was installed, in which the customary lime-soda treatment was supplemented by phosphate treatment in an external sedimentation tank, followed by filtration and deaeration. This system, operating since July, 1943 with very satisfactory results, has provided a valuable background for designing a similar system for Stanolind Station No. 3.

Return of normal conditions and plans for postwar expansion led to resumption of the engineering studies for the power plant development. Of the several cycles re-studied, the topping cycle still appeared most attractive. However, in the meantime,



RWP—RAW WATER PUMPS
TWP—TREATED WATER PUMPS
BFP—BOILERFEED PUMPS
SWP—DESUPERHEATER SPRAY PUMPS
V—VENT TO ATMOSPHERE
VC—VENT CONDENSER
S—WASTE TO SEWER
T—TURBINE
G—GENERATOR
FO—FUEL OIL CW—COOLING WATER
FW HTG—FEED WATER HEATING

1.—STEAM GENERATING UNIT
A—PRIMARY SECTION
B—SECONDARY SECTION
2.—SUPEPHEATER
3.—BURNERS
4.—LIME-SODA SEDIMENTATION TANK
5.—PHOSPHATE SEDIMENTATION TANK
6.—HEATER
7.—AGITATOR
8.—SLUDGE BLOWOFF TANK
9.—SLUDGE BLOWOFF TANK VENT CONDENSER

10.—FILTERS
11.—DEAERATING HEATER
12.—DEAERATED STORAGE
F—BOILER FEED C—CONDENSATE
13.—CONTINUOUS BLOWDOWN FLASH TANK-100 PSI
14.—CONTINUOUS BLOWDOWN FLASH TANK-10 PSI
15.—INTERMEDIATE BLOWOFF TANK
16.—PRESSURE REDUCING VALVES
17.—DESUPERHEATERS
18.—BACK PRESSURE REGULATOR
19.—MOTOR OPERATED CONTROL VALVES

Fig. 2. Simplified flow diagram for Stanolind Station No. 3, new 1250-psi topping plant for Whiting refinery, showing: interconnections with Stations 1 and 2; connections of feedwater treatment system; pressure reducing and desuperheating equipment for co-ordinating four steam pressure systems

operating experience in high pressure stations had shown that in certain 1200 psi installations, especially those with high make-up, trouble had been encountered from silica. Economic and experimental studies were made by National Aluminate Co. over a considerable period, leading to the conclusion that, with slight improvement in equipment design and the use of sludge recirculation, it would be possible with the existing method to reduce the silica content of the boiler feedwater to considerably less than 1ppm. Using this information and in collaboration with Professor F. G. Straub of the University of Illinois, the company decided to go ahead with the design of the 1250-psi 950-F topping station described here. Design was begun by Stone & Webster Engineering Corp., in June, 1945 and initial operation is expected to begin in the spring of 1948.

The new station, referred to as Stanolind Station No. 3, has been located adjacent to Station No. 1 to centralize utility in operation, to permit use of existing coal car storage and unloading facilities in the future, to reduce the length of interconnecting lines between the two stations to a minimum, and to utilize the existing raw water collecting and storage facilities.

Emphasis in the design and layout of the power station has been placed on minimum overall cost of steam and power, on continuity of service, and on dependability.

Ultimate expansion of the station provides for six steam generating units, each having a capacity of 300,000 lb of steam per hour, and five 10,000-kw topping turbine generators. Space is available for expansion of the water treating facilities to an ultimate capacity of 400,000—a total of fives two-stage hot-process softener units, including filters and auxiliary equipment. The initial installation consists of three steam generating units, two 10,000 kw turbo-generators (a third 10,000-kw unit has recently been ordered), and two hot-process softener units.

The topping turbines are designed for throttle steam conditions of 1250 psi 900 F, and a back pressure of 400 psi, full load exhaust steam temperature approximately 600 F. The generators are of the standard air-cooled type, equipped with direct-connected exciters and pilot exciters.

The topping turbines will exhaust into the refinery 400-psi steam distribution system which is also supplied by the existing 400 psi boilers in Stations No. 1 and 2. Complete inter-connections of the various steam systems are shown in Fig. 2.

To guard against accidental overloading of the generators which might be caused by the rupture of a steam distribution main, or the sudden loss of one or more of the 400 psi boilers, resulting in a rapid drop in the exhaust pressure on the topping turbines, each high-pressure turbine-generator is equipped with a load-limiting device actuated by hydraulic pressure. This device will control the steam inlet valves, permitting the turbine to supply a limited electrical load and part of the steam requirements during the trouble period. It will also permit a rapid return to normal operation when the trouble has been isolated.

Under normal conditions the pres-

PRINCIPAL EQUIPMENT, STANOLIND STATION NO. 3, STANDARD OIL CO. (Ind.)

GENERAL

Location: Whiting, Ind.
Type of Plant: Industrial Steam and Power
Capacity 900,000 lb steam per hour
20,000 kw
Designers and Constructors:
Stone & Webster Engineering Corp.

STEAM GENERATING EQUIPMENT

Steam Generating Units
Foster Wheeler Corporation
3 Dual Circulation type steam generators; Maximum Capacity each—300,000 lb. per hr. continuous; Operating Pressure — 1350 psig; Design Pressure—1500 psig; Heating Surface: Boiler—15,330 sq ft Furnace Walls—6340 sq ft.
Furnace Data: Width—22′ - 3½″, Depth —23′ - 7½″, Volume—30,800 cu ft, Liberation—13,700 Btu per hr cu ft, Tubes—bare, hopper bottom sloped 55° with horizontal
Superheaters Foster Wheeler Corp.
2 Section—multiple loop, pendent type; Steam Temperature at outlet—900 F; Range of Temperature Control—250,000 to 300,000 lb per hr; Steam Temperature control—gas by-pass damper with automatic control; Heating Surface—8490 sq ft.
Burners Foster Wheeler Corp.
6 per boiler; horzontal intervane combination type for oil and gas with provision for future pulverized coal burning. Oil burner elements are Peabody Engineering Co. Type BT, steam atomizing.
Air Preheaters Air Preheater Corporation
Ljungstrom regenerative type — 1 per boiler; Heating Surface—73,000 sq ft; Integral power driven soot blowing and washing device using 400 psig steam.
Forced Draft Fans
Green Fuel Economizer Co.
1 per boiler—Horizontal, double width, double inlet, Control—Inlet vanes; Drive —2 constant speed motors—General Electric Co. 1—200 hp, 900 rpm; 1—500 hp, 1200 rpm.
Induced Draft Fans American Blower Corp
1 per boiler; Horizontal, ⅔ double width, double inlet; Control—louver damper; Drive—2 constant speed motors—General Electric Co.; 1—300 hp, 450 rpm; 1—700 hp, 600 rpm.
Flue Gas and Air Ducts
Foster Wheeler Corp.
United Boiler Heating & Foundry Co.
Stacks Connery Construction Co.
1 per unit—11′-0″ dia. x 46′-6″ high; Brick Lining—Alphonse Custodis Chimney Construction Co.
Soot Blowers
Diamond Power Specialty Corp.
20 Rotary units operated by compressed air at 300 psig; 2 Retractable units operated by steam at 400 psig; All units under automatic control; rotary units operating on air puff system.
Water Columns
Diamond Power Specialty Corp.
Per Boiler: 2—Bi-color reflecting type with high and low alarms; 2—Plain glass.
Safety Valves
Crosby Steam Gage & Valve Co.

TURBINE-GENERATOR EQUIPMENT

1 Turbine-Generator Unit
Allis Chalmers Mfg. Co.
1 Turbine-Generator Unit
General Electric Co.
Each unit—12,500 kva, 0.80 pf, 3600 rpm, 3 phase, 60 cycle, 13,800 volt, air cooled alternator, with direct connected 50 kw, 250 volt main exciter, and 3.5 kw, 250 volt pilot exciter.
Turbine, non-condensing, non-extraction type designed for 1250 psig, 900°F T.T. at throttle, exhausting at 400 psig.
Accessories for Allis-Chalmers Unit:
Generator Air Cooler
Griscom-Russell Co.
2—Special Style "H" K-Fin Coolers in 2 sections arranged for series flow.
Oil Cooler Schutte-Koerting Co.
Twin Coolers— #5-36x-2PE—Type "K".
Oil Purification System Bowser, Inc.
#6E—Type A continuous gravity filter.
Accessories for General Electric Unit:
Generator Air Cooler
General Electric Co.
2 sections Surface Air Coolers arranged for parallel flow.
Oil Cooler General Electric Co.
Oil Purification System Bowser, Inc.
#7E—Type A continuous gravity filter.
CO_2 Fire Extinguishing System for generators Walter Kidde & Co.
Feedwater Treating Plant—
2 Stage Hot Process Type
Allis Chalmers Mfg. C.
in collaboration with
American Water Softener Co.
Details will appear in Part III
Deaerating Heaters Cochrane Corp.
Details will appear in Part III
Fuel Oil Heaters
American Locomotive Co.
2 Closed Floating head type—Size 21-192 type C1-36-44H—H.S.—1940 sq ft each. Design press.: Tubes—300 psi, Shell—150 psi. Inlet Temp. fuel oil—140F, Outlet Temp. fuel oil—200F. Steam Conditions —100 psi 450F or 10 psi 240F.
Steam Pressure and Temperature Reducing and Control Equipment Swartwout Co.
1—3″ x 4″ type V2 valve—capacity 75,000 lb/hr 1250 psig 900F to 400 psig 650F.
3—6″ x 8″ type V2 valves—capacity each unit 300,000 lb/hr—1250 psig 900F to 400 psig 650F.
Each unit complete with: Valve positioner and electrical contact, manual and automatic pressure and temperature panel controls, load limiting control, pressure water control, temperature control, atomizing nozzle, steam shutoff valve with positioner and contact, water control and shutoff valves with positioners, trip control, air lock valve and pressure alarm switch.
1—8″ x 10″ type V2 valve—capacity 300,000 lb/hr—400 psig 650F to 100 psig 450F; 1—10″ x 16″ type V2 valve—capacity 150,000 lb/hr—100 to 10 psig.

CONTROLS AND INSTRUMENTS

Combustion Control System
Bailey Meter Co.
Complete combustion control system designed for automatic regulation from station steam pressure of air, furnace draft, fuel gas and fuel oil with provision for future pulverized coal, including pressure recorder controller.
Feedwater Control Bailey Meter Co.
Multipoint Draft Gages Bailey Meter Co.
Temperature Recorder—Boiler Temperatures, Smoke Density Recorder; Conductivity Recorder—Steam Leeds & Northrup
Boiler Pressure Gages
Crosby Steam Gage & Valve Co.
Flow Recorders—(Water, steam, gas and oil) Brown Instrument Co.
Temperature Recorder Controller — Fuel Oil Heaters Brown Instrument Co.
Temperature Recorders—multipoint
Brown Instrument Co.
Temperature Recorders—multipoint
Leeds & Northrup Co.
Pressure Gages and Temperature Indicators—Dial Type
Manning, Maxwell & Moore
Industrial Thermometers
Taylor Instrument Co.
pH Recorder Leeds & Northrup Co.
Pressure Gages—Master Pilot, Double illuminated Ashton Valve Co.
Instrument Panel Boards Kelek Co.

PUMPS AND COMPRESSORS

Boiler Feed Pumps Ingersoll-Rand Co.
4—845 gpm Type CHT-8, 8 stage, 3600 rpm, 1660 psig disch. press., Drivers: 2—1250 hp GE motors 2—1500 hp Westinghouse type C-225 turbines.
Raw Water Pumps Ingersoll-Rand Co.
3—2400 gpm Type 8ALV, single stage 1800 rpm, 226 ft total head. Drivers: 3—200 hp Continental motors.
Treated Water Pumps Ingersoll-Rand Co.
3—2400 gpm Type 8ALV, single stage, 1800 rpm, 200 ft total head. Drivers: 2—150 hp Westinghouse motors, 1—150 hp Terry turbine, type ES.
L.P. Cooling Water Pumps
Ingersoll-Rand Co.
2—1500 gpm Type 6AFV, single stage, 1800 rpm, 105 ft total head. Drivers: 2—50 hp General Electric motors.
H.P. Cooling Water Pumps
Ingersoll-Rand Co.
2—500 gpm Type 3BEV, two stage, 1800 rpm, 230 ft total head. Drivers: 2—50 hp GE motors.
Backwash Pumps Ingersoll-Rand Co.
2—1500 gpm Type 8LFV, single stage, 1800 rpm, 78 ft total head. Drivers: 2—40 hp GE motors.
Vacuum Cleaning System Pump
Ingersoll-Rand Co.
1—650 gpm Type 4UV, single stage, 3600 rpm, 100 psi total head. Drivers: 60 hp Crocker-Wheeler motor.
Desuperheating Water Pumps
Pacific Pumps, Inc.
3—158 gpm Size 2″ S, Type JB, 5 stage, 3600 rpm, 598 psi total head. Drivers: 2—125 hp GE motors; 1—100 hp Terry turbine, type ES.
Fuel Oil Pumps
Worthington Pump & Machinery
3—200 gpm, 3″ UB-1, 2 stage, 1800 rpm, 350 ft total head. Drivers: 2—75 hp Imperial motors, 1—69 hp Terry turbine type ES.
H.P. Air Compressors Ingersoll-Rand Co.
2—332 cfm Class ES-2, size 12-6 x 13 horizontal tandem, 350 psig disch. press., 257 rpm, with V-belt drive—125 hp, 900 rpm GE motors. 1—American #2-OCH air intake filter.
Instrument Air Compressors
Westinghouse Air Brake Co.

ELECTRICAL EQUIPMENT

13,800 v Switchgear and Control
General Electric Co.
16—1200 amp. Type M1-6 vertical lift metal clad air circuit breakers (1 spare); 1—Excitation Switchboard—250 v metal clad; 1—Duplex main control board; 1—Generator neutral oil circuit breaker cubicle; 2—Voltage Regulators.
2300 v Switchgear General Electric Co.
4—2000 amp. Type M1-6 vertical lift metal clad air circuit breakers. 26—600 amp. Type M1-6 vertical lift metal clad air circuit breakers (1 spare).
480 v Switchgear General Electric Co.
4—1200 amp and 12—300 amp metal clad air circuit breakers.
Battery and Lighting Switchboard
Kinney Electrical Mfg. Co.
Transformers General Electric Co.
3—6250 kva Station Service Transformers, 3 phase, 60 cycle, 13.8/2.4 kv O.I.S.C.
3—500 kva Station Service Transformers —3 phase, 60 cycle, 2400/480 v O.I.S.C.
2—150 kva Lighting Transformers — Single phase, 60 cycle, 2400/120/240 v O.I.A.C.
Spare Exciter Westinghouse Electric Co.
1—50 kw 250 v generator with 0.5 kw pilot exciter. Driver: 75 hp 2300 v 3 phase, 60 cycle, 1800 rpm motor.
Battery Charging Motor Generator Set
Allis Chalmers Mfg Co.
1—15 kw 90/140 v generator 25 hp 1800 rpm motor.
Control Storage Battery
Electric Storage Battery Co.
1—60 cell, 125 v type FOS-21 Exide battery; 1—Model ESm Exide charge control unit.
Reactors General Electric Co.
6—Type CLS cast in concrete current limiting reactors, single phase, 60 cycle.
Indoor Bus Supports, Disconnecting Switches, Fuse Mountings
General Electric Co.
Potheads G&W Electric Specialty Co.
440 v Motor Controls, Push Button Controls, Power Distribution Cabinets
General Electric Co.
Cable and Wire—Oil Base insulated wire
General Cable Corp.
Varnished cambric insulated wire and cable General Electric Co.
Interphone System Graybar Electric Co.

PIPING, VALVES AND ACCESSORIES

Piping N. W. Kellogg Co.
Valves
1500 lb boiler non-return valves— (Limitorque motor operators)
Edward Valves, Inc.
1500 lb feed line lift check valves, boiler feed stop-check valves, boiler blow off valves and miscellaneous boiler valves
Edward Valves, Inc.
1500, 600, and 150 lb cast steel valves Limitorque motor operators)
Crane Company
1500 lb forged steel calves
Henry Vogt Machine Co.
1500, 800 and 600 lb Hancock weld valves
Manning, Maxwell & Moore
L. P. Cast Iron and Brass Valves
Crane, Chapman Valve Mfg. Co.
Lubricated Plug Valves for fuel gas service Nordstrom Valve Co.
Pressure Relief Valves
Manning, Maxwell & Moore
24″ Low Pressure Relief Valve
Atwood & Merill Co.
Gas Pressure Regulator—Pilot Operated
Swartwout Co.
Water, Air and Oil Pressure Reducing and Relief Valves Fisher Governor Co.
Liquid Level Control Valves for Continuous Blowdown Flash Tanks
Fisher Governor Co.
Temperature Control Valves—Fuel Oil Heaters Fisher Governor Co.
High and Low Level Alarms—Continuous Blowdown Flash Tanks Magnetrol, Inc.
Expansion Joints—
Copper—corrugated type
E. B. Badger & Sons Co.
Sleeve Crane Company
"Harness" type Dresser couplings
Dresser Industries, Inc.
1500 lb steam traps
Armstrong Machine Works
Sample Coolers Parker Appliance Co.
Strainers—water and fuel oil Andale Co.

ent 400-psi turbines and the new topping turbines will be operated by manual governor control to distribute load between the turbines and maintain the speed of the system. For this reason, a back-pressure regulating device will not be used to control the steam flow to the turbines but the balance between the electrical load and the steam demand will be maintained by automatic pressure reducing and desuperheating stations.

Steam Generators and Auxiliaries

The principal features of the steam generating units will be described in Part II, in a subsequent issue, and those of the water treatment system in Part III, particularly with respect to the novel character of the circulation system.

Each boiler is fired by six burners of the intervane type arranged for firing with fuel oil and refinery gas. Provision has been made to permit installation of internal elements for pulverized coal firing in the future.

Heat recovery treatment consists of a regenerative type air preheater for each boiler. The total height of the elements is 60 in. with 12 in. at the cold end of widely spaced Corten steel. A motor-operated dual-nozzle rotary cleaning device is provided for each preheater, with 400 psi steam as the cleaning medium. Temperature control of the cold end will be obtained by a cold air by-pass and by recirculation of heated air.

Air for combustion is supplied for each boiler by a forced-draft fan driven by two constant-speed motors. Control of the air supply is by means of inlet vanes and by shifting from one motor to the other through the combustion control. Air can be drawn through the intake ducts either from the upper part of the boiler room or from outside the building, or can be proportioned by dampers as desired. Air intake louvers are provided in the walls of the boiler room near the main operating level.

Flue gases are removed by an induced-draft fan, also driven by two constant-speed motors, with control similar to that for the forced-draft fan. Both fans can also be controlled manually from the boiler gage board.

Space has been allowed in the layout for future installation of a mechanical-type dust collector between the air preheater and the induced-draft fan.

Steam Conditioning and Co-ordination of Four Systems

Inequalities in the demands for steam and power are taken care of in the new station by steam conditioning equipment. For normal operation this function is supplied by two pressure reducing and desuperheating stations, one having a capacity up to 75,000 lb per hr and a second with a capacity of 300,000 lb per hr. The larger unit is designed to cut in automatically when the smaller reaches the limit of its capacity. Two additional stations with a capacity of 300,000 lb per hr have been provided one a standby and one to safeguard the refinery steam supply in case one of the topping units should trip out. This installation will be sufficient to serve the ultimate plant.

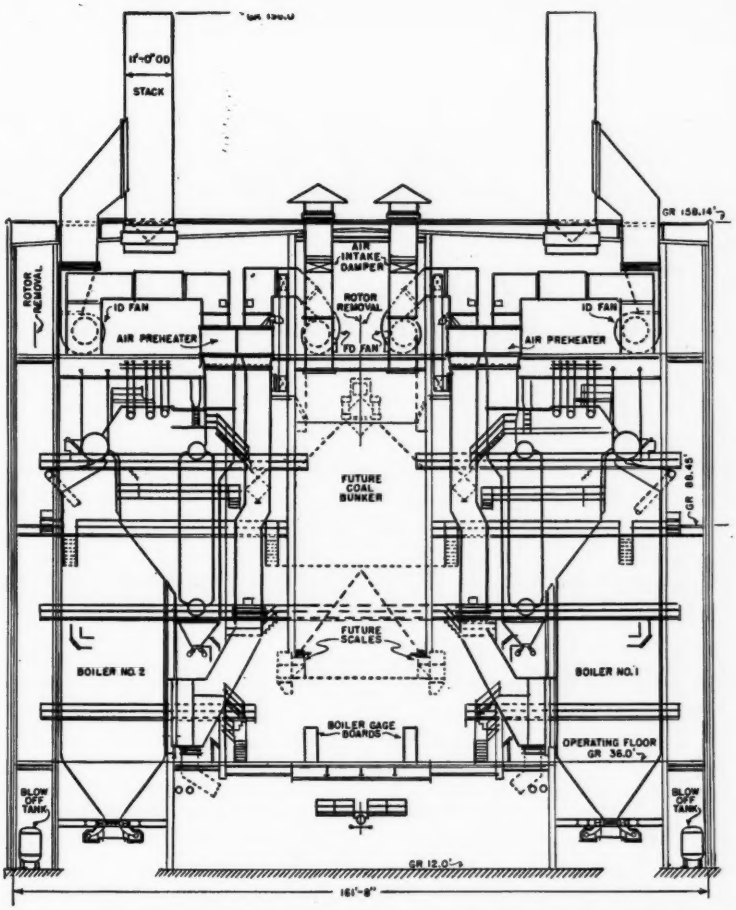


Fig. 3. Longitudinal section through boiler room of new 1250-psi topping steam plant, Stanolind Station No. 3

Each station consists of a diaphragm-operated pressure-reducing valve of the pilot type and a steam-jet, water-spray-nozzle type desuperheater. Condensate for the spray water is obtained as shown in Fig. 2 by condensing vapor from deaerating heaters in oversize vent condensers, with relatively cold raw water, on its way to the feedwater treating plant. The condensate is deaerated in a separate section of the deaerator and collected in a compartment of the deaerater storage tank, Fig. 2. When the supply of condensate is greater than the demand, it overflows into the adjacent compartments of the storage tank containing deaerated boiler feed water. For emergencies a supply of condensate is stored in a 300,000 gal tank located at the level of the deaerator storage tanks. Desuperheater spray water pumps are located on the main operating floor. Fig. 1. All controls for the equipment are on a panel at main operating level.

Noise associated with the pressure reducing valves of the type usually employed for this service is quite objectionable to the operators, although considerable improvement has been effected by changes in the design of valves and piping in recent installatins and the noise level has been appreciably lowered. In this installation, because of the large number of units involved, it was considered desirable to isolate this equipment as much as possible, therefore it has been placed in a separate room above the roof of the turbine room and isolated from the boiler room by a solid brick wall. The walls of this room will be lined with acoustic material to further deaden the sound.

Electrical Features

Power is generated at 13,800 v, 3 phase, 60 cycles. Power is distributed to the refinery at 13,800 v through underground ducts by way of a series of cable vaults located just outside of the electrical bay. The motors driving fans and boiler feed pumps are

(Continued on Page 118)

ATOMICS

A New Section added to POWER GENERATION to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Where Are We Heading in Atomic Development?

Atomic energy in a troubled world. Where are we heading? Why the long delay in the development of atomic power plants? What are the scientists doing and what is going on in the laboratories? These are questions in which the public is interested. The answers so far as they can be given, are given here

By ANDREW W. KRAMER, Editor, Power Generation

TWO AND A HALF YEARS after Hiroshima finds the world restless, confused, uncertain about many things, particularly about the question of atomic energy. The initial astonishment, the horror, the subsequent excitement and awe over the achievement of the atomic bomb has died away and in its place has arisen a feeling of doubt, mistrust and in the mind of the public, lethargy. The first noble hope of international accord, of intelligent action upon recognition of a common danger has slowly faded. The scientists, in their battles for atomic energy control, are no longer headline material and their glamor and novelty have run out.

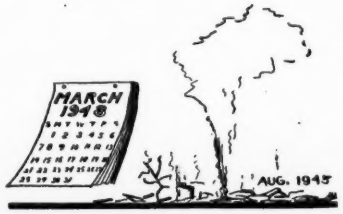
For a while many thinking people hoped and felt that perhaps the scientists could lead the way to peace. All other prophets had feet of clay, but the statements of scientists were founded on fact and verifiable experience.

Now, however, it is slowly being realized that scientists cannot come up with answers where no answers as yet exist. A large share of these answers are quite outside the special experience and sphere of the scientists. This is true not only in the sphere of political control but also in developing the peacetime uses of atomic energy. After early predictions of atomic power plants in from 5 to 7 years, now we find that it will be from 10 to 20 years before atomic power becomes practical. Were the scientists wrong in these early predictions?

The answer to this question is, no. The scientists, if they were the ones who made these predictions, were not wrong. It would be possible to produce atomic power plants in from 5 to 7 years, *if* we were willing to spend money. If we were willing to put forth the same kind of effort that we put into the production of the atomic bomb we could have a practicable atomic power plant in operation in, say 5 years, but the fact remains that we are not willing to put forth that kind of effort. For war, yes, the human race will starve itself, work its finger-tips to the bone, undergo almost any hardship, but not for peace. For peace, events must follow their slow, haphazard, uncertain course.

The situation, however, is not quite as discouraging as it may appear from a superficial appraisal. If we seem to be stymied in obtaining political action, there is a great deal of activity on the physical side. Today, physics is booming. In laboratories all over the world, physicists are at work on problems which were interrupted by the war and scarcely a month passes when there is not an announcement of some new discovery. To the extent that they are embarked on another great adventure of exploration and understanding, physicists can count themselves happy. For a while at, least, in the operation of their cyclotrons, they can put their worries over the moral aspects of their work aside and not question too seriously where they are heading.

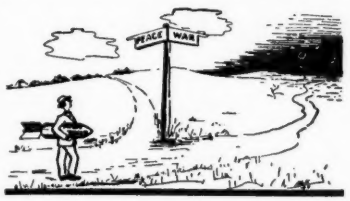
Now, what exactly is going on in the field of atomic research? Where are we heading? The "secret" nature of all atomic enegry activities make



Two and a half years after Hiroshima

these questions difficult to answer but the recent report to Congress of the U.S. Atomic Energy Commission gives us a good general picture of what is going on, at least insofar as development of nuclear reactors is concerned.

The nuclear reactor, however, represents only one aspect of nuclear research. Dispite its great importance in the development of the atomic bomb and its potentialities in the future production of atomic power, it must not be assumed that all nuclear research and development centers around the nuclear reactor. In the article on developments in high-energy physics in the January issue[1] I



Where are we heading?

described a number of the new accelerating devices being used in nuclear research. Such accelerators have little relation to the neculear reactor, yet it is from the operation of these accelerators that much of our new knowledge of nuclear physics is being derived.

Dr. J. Robert Oppenheimer, the former Director of the Los Alamos Laboratory and now Director of the Institute for Advanced Study calls attention to this in the March number of the Bulletin of the Atomic Scientists. "One may have gained the impression" writes Dr. Oppenheimer, "that this boom (in nuclear physics) derives primarily from the application of the new techniques developed during the war, such as the atomic reactor and micro-wave equipment; one may have gained the impression that in large part the flourishing of physics lies in the exploitation of the eagerness of governments to promote it. While these are important they are only a small part of the story. Without in any way deprecating the great value of wartime technology, one nevertheless sees how much of what is today new knowledge can trace its origin directly, by an orderly yet imaginative extension, to the kind of things that physicists were doing in their laboratories and with their pencils almost a decade ago."

Physicists today are continuing the attempt to discover to identify and characterize, and ultimately to order, our knowledge of what the elementary particles really are. Strangely enough, in the course of this work we are learning again how far our notion of *elementarity*, of what makes a particle elementary, is from the early atomic ideas of the Greek atomists or even the chemical atomists of a century ago. We are finding out that what we are forced to call elementary particles retain neither permanence nor identity and they are elementary only in the sense that their properties cannot be understood by breaking them down into subcomponents.

Almost every month has surprises for us in the findings about these particles. We are continually meeting new ones for which we are not prepared and we are learning how poorly we had identified the properties even of our old friends among them.

Until quite recently our sharpest tool in penetrating this strange new world was our observation of the interaction of cosmic rays with matter. The next few years, however, will see an important methodological improvement, when the great program of ultra high energy accelators begins to get under way.

Developments in Nuclear Physics

This program is one of the most expensive parts of physics and has been greatly subsidized by the Government, primarily through the Atomic Energy Commission and the Office of Naval Research.

Another factor in the refinement of our knowledge is our increasing understanding of the behavior of elecrons within atomic systems. This, which is based to a large extent on the micro-wave techniques developed during the war, has provided a new vigorous criterion for the adequacy of our knowledge of the interactions of radiation and matter. Thus, we are beginning to see in this field at least a partial resolution, perhaps more than that, of the paradoxes that have plagued the professional physical theorists for several decadees.

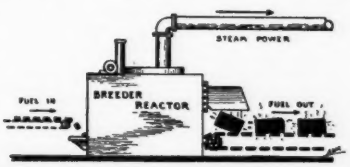
A third element in the advance in atomic physics is our increasing understanding of those forces which give to atomic nuclei their great stability, and to their transmutations their great violence. It is the prevailing view that a true understanding of these forces may well not be separable from the ordering of our experience with regard to elementary particles, and that it may also turn on an extension to new fields of recent advances in electro-dynamics.

The public little appreciates or understands the importance or the nature of the research that is going on in the laboratorities throughout the world today. A new development in the meson theory of nuclear force, for example, means little to the average person, even to those of more than ordinary intelligence, not only because it is far removed from his daily life but because he is not familiar with the picture as a whole. In other words, he cannot understand how further knowledge regarding the meson may clear up a whole mass of apparently unrelated obscure matters. He does not consider that each small increment of knowledge adds to our sum total of knowledge and that as time goes on, more and more, will we be able to apply this knowledge to practical purposes.

Of course, these matters having to do with our further understanding of nuclear physics have little relation to the delay in the development of an atomic power plant. As pointed out frequently in these pages, the principle of the atomic power plant is clearly understood; no great new fundamental discoveries are necessary. All that is needed to produce a practical atomic power plant is the solution of a number of extremely difficult engineering problems. Most of these involve the use of suitable materials.

Atomic Power to be demonstrated at Brookhaven

According to Dr. L. B. Borst, Chairman of the Nuclear Reactor Project at Brookhaven National Laboratory, it is expected that the generation of power from nuclear reactions will be demonstrated at Brookhaven some time within the next two years. The Brookhaven reactor, however, is planned for research rather than for a power plant and the power generated will be a by-product. Contracts



This looks crazy but it appears possible. Here is a power plant which while it produces power, turns out more fuel than is put into it

are now being negotiated for a steam plant which derives its power from this nuclear pile. The steam will generate electricity which will be used for driving cooling fans and other apparatus.

As Dr. Borst points out, because of the excellent coal resources in the United States, it is quite possible that atomic power will become economically sound in other countries before it can compete with other sources here. England is directing her research in atomic energy to relieve her coal shortage. They already have a reactor in operation from which they expect to extract power on an experimental basis. The same is true in France. There, coal is imported at a cost of $20 a ton, hence atomic

(Continued on page 120)

[1] Recent Developments in High Energy Physics, By Andrew W. Kramer. January issue, Page 9.

The PRACTICAL ENGINEER

DEVOTED TO PLANT OPERATION and MAINTENANCE

A. W. KRAMER, EDITOR

Electricians Are a Healthy Lot

Recent figures on occupational diseases reveal that electricians live longer than the 66 year average. Statistics indicate that they have decided advantages when compared to other occupations. Electricians are a healthy lot!

By DR. W. SCHWEISHEIMER

DURING THE YEARS 1922 to 1924, electricians in the U.S. lived a distinctly shorter life than the 56 years of the average male population. The life expectation of most industrial workers in that past period was lower than that of the average of the population.

New figures which have been published recently, show the length of life at the record high of about 66 years in the industrial population. For many decades the length of life of industrial workers of all kinds was less than that of the average person of the total population. It seems that both working conditions and the general standard of living had been worse among industrial workers.

This condition has changed considerably. The two graphic lines which represent the average life of the total population and that of the industrial population, grew closer together through the years. Today, they both are on appriximately the same high level. Almost five years of life extension were gained in the last ten years alone, nearly 9½ years in the past twenty years, and more than 18 years in the past third of a century.

Special Figures for Electricians

Recent studies by Louis I. Dublin and Robert J. Vane of the Metropolitan Life Insurance Company have shown remarkable differences in the death rate (mortality) from certain diseases in different occupations. There are special figures for electricians in these statistics, and they have decided advantages when compared with other occupations. Most of the figures are close to the average or better.

The figures for tuberculosis of the lungs is only 74 per cent for electricians, compared with the average figure of 100 among all occupied males, ages 15 to 64 years. This is one of the lowest percentages of all occupations. The death rate from pneumonia is 108, which may or may not be connected with the outdoor exposure of electricians. The figure for organic diseases of the heart is 100, the average of all ocupations, for principal diseases of heart, blood vessels and kidneys 106, that for cerebral hemorrhages and apoplexy only 83. Figures for cancer are about average.

The only figure which shows a remarkably higher percentage is that of accidents, which is 138. The Metropolitan Life statistics have, furthermore, special figures for accidents of electric light and power linemen. With a percentage of 374 it is the *highest* percentage of all accidental deaths, indeed a shocking figure. Almost three-fifths of the fatalities were caused by electric shock, and another fifth by accidental falls. More than four-fifths of all accidental deaths among electric light and power linemen were of occupational origin. These are alarming figures, but none that are out of reach of prevention and improvement. For comparison's sake: the lowest accident figure is that of tailors and other clothing workers, with a percentage of 60.

People Live Longer Today

Electricians and other industrial workers today live longer than 66 years on the average. Since the beginning of history the average length of life has steadily increased, even if we should assume that some single persons have reached a high "biblical" age in antiquity. A most interesting study of the Metropolitan Life Insurance Company has followed up the average length of life from ancient times to our modern days. The march of civilization has been accompanied by a progressive increase in the average length of life. The greatest increase in longevity was in the past century, due to outstanding medical achievements, hygenic progress, and the general improvement in living and working conditions.

The average span of life of the prehistoric man in the early Iron and Bronze Age has been estimated at only 18 years. This, of course, does not mean that there were none surviving to mature life in the Bronze Age; surely there were men of 70 years of age even at that time, but that the number of deaths in early infancy and childhood were terrifyingly high. In ancient Greece and Rome the average length of life was somewhere between twenty and thirty years, and in the Middle Ages around thirty-five years. In the United States, around the turn of our century, the average length of life had risen to 49 years, and in 1945 it was 65.8 years. This record of progress by the Metropolitan Life says it is undoubtedly without parallel in the whole range of human existence, and may never be equaled.

Yet, further progress is still possible. Within the course of the next decade or two, extension of the average length of life to at least 70 years should be possible.

Causes of Better Health of Electricians

The main reason why electricians and related occupations live longer today and enjoy better health, except for the high incidence of accidents, is the same as those for the general population—improvements in the hygiene of everyday life and better working conditions. The housing situation, though bad at present in many countries, is incomparably better for the mass of the people than it was in the Middle Ages or even half a century ago.

Better nutrition has strengthened the general resistance against disease of any kind. The danger of epi-

demics can be limited in most cases. Progress in medicine and surgery is of advantage to every age group. The use of insulin alone, discovered in 1921, has given a longer life and full working efficiency to innumerable diabetics who previously had felt like invalids.

Better protective laws take care of the health of the worker, they prevent child labor which had so many victims in former times. Poisonous materials are eliminated from all producing processes, and where this cannot be done, extraordinary precautions are prescribed for protection of those who handle such material.

There is much more understanding for occupational diseases in connection with the health of the working people and the actual level of production. Conditions are not a hundred per cent perfect everywhere, as can be clearly seen from the accident figures of electricians and electric light and power linemen, but you have only to compare the average electric store of today with that early in the century to be aware of the decisive progress in the daily hygiene and the working conditions.

Conditions are particularly better for the older group of electricians, and this is the more important since the older age group forms a steadily rising percentage of working electricians. People not only live longer, they stay young longer and capable of work as well. Statistical experts see good reason that mortality of the older age groups will improve still further in the coming decades, and death will be postponed.

The eminent value of older workers in trade and industry has been shown clearly in some recent publications. In Canada, Dr. Lydia G. Giberson has stated that the skilled worker, on the average, is well beyond his fortieth year of age, and he is all important to production. Dr. Carlson, in an extensive report to the Congress on Industrial Health in Chicago, has drawn the conclusion that by forced idleness of the increasing army of older workers in our midst, we are forging a dangerously weak link in that large part of society whose experience, wisdom, and relative unselfishness could guide those with less experience and wisdom.

PRACTICAL ENGINEER SECTION

A-C Supply, D-C Drive

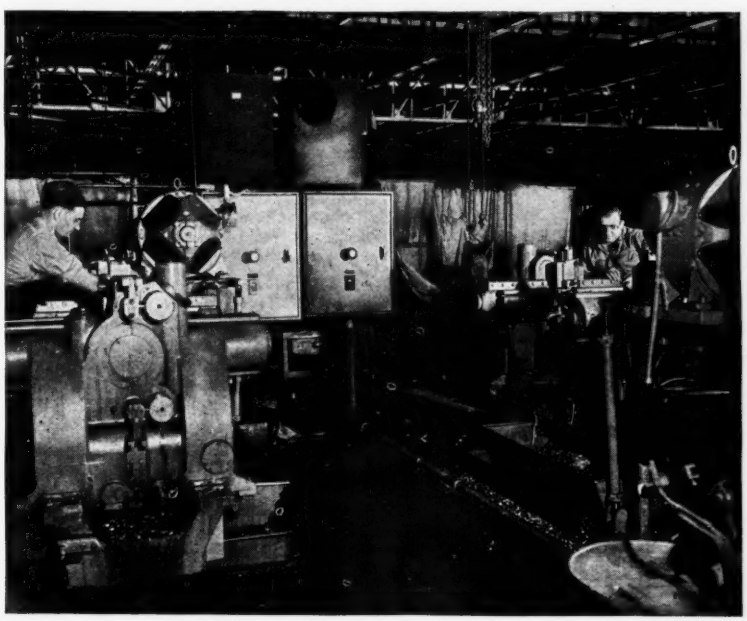
THE COMBINATION OF A-C SUPPLY AND D-C MOTORS for industrial drives is hard to beat. Westinghouse has developed at least two ways of operating d-c motors on a-c lines using rectifiers that are currently highly successful. In one, the intervening link is the selenium-type of dry-disc rectifier. The other is a controlled tube-type rectifier. The selenium-rectifier scheme is simpler, but does not give as wide a speed range (it furnishes a constant d-c voltage) or as close control as the tube.

The selenium-rectifier is being used for six sizes of 230 v motors between one and 15 hp. The rectifier, controls, auto-transformer, and (in the larger sizes) a fan to keep the stacks cool are housed in a small cabinet, which is placed at any nearby convenient location. Selenium rectifiers bring about a significant saving in size and weight, as compared with the copper-oxide type or with motor-generator sets.

The metallic rectifier allows use of conventional d-c control. However, on the 1- to 7½-hp sizes, its natural internal resistance makes it possible to omit d-c starting control and retain only the barest essentials—a standard a-c linestarter and a field rheostat. Either reversing or dynamic braking are obtained readily. Voltage and speed regulation using the rectifier are comparable to those of a motor-generator set. Commutation, which one might expect to be adversely affected by the rectifier ripple, has proven to be excellent in months of actual operation on a variety of machine tools.

The tube-type d-c motor control, called Mototrol, appeared several years ago and has recently undergone a working-over in accordance with industrial practice. The result has been some simplifications, a reduction in the number of tubes for certain sizes, and substitution of industrial-type components in place of radio-type, Inerteen-impregnated capacitors have replaced the paper type and industrial relays the telephone type.

One new use for Mototrols, which indicates the rugged service to which they are being exposed, is in steel mills to drive alloy strip, through annealing furnaces and pickling tanks. The power requirements are small, 3½ to 7 hp, but the speed must be adjustable and closely regulated over a wide range—much more than the four to one possible by field control of a standard d-c motor. Mototrol power supply and control equipment is all stationary and is contained in a small cabinet. The drive is excellent as it gives precise speed control over the 4- to 32-feet-per-minute speed range of the processing line and a 2½ to 1 speed adjustment as the strip being wound up on the reel increases in diameter. By both field and armature control, a speed range of 20 to 1 is obtained. The performance to date of over a dozen Mototrol drives on these processing lines has been eminently successful.



D-C motors operated through rectifiers from a-c power sources prove most versatile in their speed control

So—You Are Going to

By CYRIL F. GREENE
Resident Engineer, Traveler's Insurance Company

FOREWORD: When the author uses the term "Examination" he does not refer particularly to any special kind of examination but rather to any and all examinations that may be required in the various lines of engineering work. When the word "Examiner" is used, it is meant to apply to one man or a board of three or more.

THE PEOPLE who are required to take examinations are those whose experience and ability must be carefully considered in order that the health, safety or financial security of the public may be protected. Doctors, dentists and lawyers must pass examinations before they can engage in the public practice of their work, and so must many of us who are engaged in the various branches of engineering work. Usually the examination is required by law in the state or city where our job is located. That makes it plain that examinations are definitely in the public interest and that those who pass them are the ones most likely to handle their job in a safe manner.

While an examination is required by law for certain lines of engineering work there is no law that can force you to take an examination any more than the law can force you into undesired self-improvement such as attending evening school classes or subscribing to good technical magazines to aid you in learning more about your work. When you take an examination you will do it of your own free will. No one will march you into the examination room at gunpoint and, on the other hand, neither will anyone try to use force to prevent you from taking the examination. If you take the examination you will take it for the same good reasons that thousands of men have used before you as a sound basis for hard work and study, namely, a better job, higher earnings and improved opportunities for your family.

The Proper Attitude at Examination Time

Having come to the conclusion that it is in our best interest to prepare for and take the examination, let us now proceed to take a look ahead and see just what we need to do in order to see this examination business in its proper light. We have already learned that we cannot be the victim of interference in our work and study and since this is so we must make very sure that we are not going to hinder or delay ourselves in this important matter. In order to do this properly let us proceed to look into those things that men think about at such times in order that we may be sure that we have everything that we need and nothing that is not needed. At this point we are like the mountain climber who stands at the base of the mountain looking upwards to the summit towards which he will soon start to climb. The equipment that he requires he definitely should have, but excess things that are not needed will become more and more of a burden as the climb progresses.

The heaviest burden and the one that we should get rid of at the very start of our studies is being afraid of the examiner. The examiner is a public servant just like a police officer, a school teacher or a member of Congress. Law abiding people do not fear public servants since they work for the public good—and so does the examiner! If, at this point, you think that the advantage in an examination is mostly on the side of the examiner then you may be sure that you have not given that part of the matter very careful thought, particularly if this is going to be your first examination and one which will consist entirely of questions which will be asked and answered orally. In order to make this matter of who has the better advantage a bit clearer let us look into the case of Bill Smith.

The Case of Bill Smith

Bill is twenty-six years old with three years of high school. He is a good worker and a reliable man. After knocking around on various jobs since getting out of school, he came to the Jones Manufacturing Co. six months ago where he went to work as a general helper in the power plant. Bill's work consisted mostly of caring for and operating the coal and ash handling equipment and lending a hand on repair work. Bill liked the job better than any work that he had done previously and decided to stay with it; so he cornered the Chief one day and asked for the first chance at a regular job in the boiler room. The Chief was very agreeable to giving Bill the chance, since he had observed that Bill was a good worker and a reliable man, but he reminded him that the law required that boiler operators must be licensed. If Bill could get the license, he would be glad to give him the chance that he was asking for.

Let us skip over the work that Bill did to get ready for the examination and pick him up as he sits down in front of the examiner. The examiner has Bill's application on the desk in front of him, and since Bill has never actually been responsible for doing the work that he wants the license for, the application form isn't really much help to the examiner as far as finding out how much Bill knows about the work. That leaves the examiner with two methods to use on Bill. First of all he can question him as to his knowledge, and secondly, he can use his skill in sizing up men to figure out the type of fellow that Bill is. Let us remember at this point that if he licenses Bill the responsibility is all his. It is his signature that will be on the license as long as the license is in force. What will he have to back up his judgment in case Bill gets into trouble? Nothing, since there is usually no record kept of questions and answers in examinations of that type.

What then can Bill do to help the examiner to make a proper decision? Mostly he can help him by showing clearly that he is not afraid of the examiner and that he has prepared himself carefully for the questions that the examiner will ask him. Perhaps the idea of helping the examiner strikes you as being unusual or even funny, but it is beyond doubt that you help yourself by going to the ex-

Take an Examination!

Examinations are required by law for various branches of engineering work to make certain that those who pass them are the ones most likely to handle their job in a safe manner. Passing an examination means a step forward; usually a better job, higher earnings, and improved opportunities. For these reasons a fear of the examiner or the examination is unjustified. Preparing for and passing an examination is not easy; lots of hard work, careful study, and confidence in one's ability, are required. Part 1—The Proper Attitude Toward an Examination.

amination with that idea in mind. Of course, you remember the school teacher who used to add a few points to your examination mark "for neatness." She wasn't giving you the points half so much for neatness as she was to save time and work for herself in grading your paper. So you see the examiner does not hold all the cards. Maybe the whole thing levels off about even and that is fair enough.

Examination Bugaboos

Next, let us look at the man who insists that he finds it "hard to learn things." The author's experience with such chaps has convinced him that they learn just as well as the others but that a bit more time for this learning is required. On the other hand, having once learned the facts that they are seeking, they make them very much their own and rarely forget them. Too often they are tempted to be discouraged by the easy manner in which a fellow employee or a pal in the same line of work seems to catch on to things. At this point let us again remind ourselves that this examination is going to be our own experience entirely free from what anyone else may say or think of our effort. Let us also take another look at our mountain climber as he makes steady and patient progress—step by step!

"Too Old to Learn"

Then comes that one about "when a fellow gets to be as old as I am, it isn't easy to study and learn things." This wrong statement has been an unnecessary handicap to many men who when getting near the top should finish their course at an easy pace with the wealth of their experience to aid them on the final leg of the journey. We who work in any branch of engineering should be far too smart to be tricked by this "too old to learn" bugaboo. It is in the engineering business that many of the greatest changes of recent years have taken place and the older men have had their part both in developing the new things or learning all about them. Does anyone think that our greatest engineers, scientists and educators who are over forty years of age are lying awake nights worrying because they are afraid that some time soon a new thing will come along that they will be unable to learn about? On the contrary, they are getting a good night's sleep so as to be up bright and early in the morning to see what new thing can be learned.

Do you have the feeling that you are lacking in the amount of practical experience necessary to obtain the grade of license that you are working and studying for? Do you especially feel this way when one of the fellows in your plant who has moved around quite a lot starts to tell about the different plants that he has worked in and all the kinds of equipment that he has handled? If he is the type that talks easily and interests the boys without seeming to brag, you are more than ever inclined to think that you haven't been very far or seen much of anything. You should not feel that way at all, so let me now explain to you why worrying about the experience part of the matter is wholly unnecessary.

Let us suppose that I asked you to figure out for me the cost of twenty-seven crates of oranges at seven dollars and eighty-three cents a crate. Simple? Of course! Now let us suppose that just as you were about half way through your figuring, I stopped you and told you that I had been mistaken, and that the crates were full of apples instead of oranges. However, the number of crates remained the same and so did the price. Would you be confused? Would your figuring be slowed down? Certainly not! The reason that you would not be thrown off the track by the change that I made in the problem was because the numbers and the *principle* that governed them, was unchanged.

Always bear in mind that it is the *principle* of the problem that we must understand if we are to give a sensible answer. For example, the fact that you have never operated or even seen a certain make of injector is not too important to either the examiner or yourself. On the other hand, it is highly important that you understand the principle on which injectors operate and can describe this principle in simple terms and also be able to tell just as simply what would interfere with their proper operation. The examiner would properly expect that you should be able to do this. Taking a last look at our mountain climber as he gets nearer to the top of his mountain we can easily understand that the experience that he is gaining on this mountain could not fail to help him in climbing other and higher ones.

Lots of Jobs Does Not Mean Lots of Experience

Going from job to job in search of experience can be overdone. The plant executives who invest millions of dollars in power plant equipment are naturally looking for men who are studious and reliable to take charge of their equipment. Obviously then you cannot blame them for looking more sharply than usual at the man who has knocked around to the point where they wonder just why he moved around so much. The examiner knows too that the average employer is looking for reliable, steady men and if the man of that type has studied carefully and understands the principle of the things that he is learning then he will find that lack of wider experience will not handicap him at examination time.

Have you fallen for the un-Amer-

PRACTICAL ENGINEER SECTION

ican rumor that your particular examiner is apt to favor the members of a particular group? Just realize right now that if he did that it would become more and more noticeable as this group gained more licenses at the expense of all the other applicants. Did you ever see that happen? Do you ever really expect to? Certainly not, since it doesn't make sense. Most all examiners are officers of some form of government and nothing would threaten their security or impair their chances for adancement any more than to show favoritism.

What you have read so far in this article covers the points of greatest concern to the man who is studying for his first examination or the one who is going progressively higher in his work and responsibility. It is best that at this time we should pause and review the important matters that we have thus far discussed. Before we do it, let us be in agreement that nowhere in this article has it been even lightly hinted that preparing for and passing an examination is easy work or that the examiner will qualify us simply because we make application to be examined.

Just as in every other walk of life, progress and reward comes earliest and stays longest with the one who is most willing to work and study for it.

Summary

Now for our review! Are we not in agreement that the man who is looking towards an examination should be untroubled by thoughts that will hamper him in his work? Then let us remember that fear of the examiner or the examination is absolutely without any sound basis since both will contribute to our own advancement and the good of all of us. We will agree not to yield to discouragement because we seem a bit slow to learn or because we believe that our age is against us in the matter of learning. We will study to learn the principle of the things that we should know and not be afraid that our experience is less than it should be.

Finally, we will believe in the complete fairness of the examiner and the organization that he represents.

Having reached these conclusions we find ourselves well prepared mentally to either start our journey towards the examination or to carry on the work which we are now doing along that line.

Thread Cutting in the Lathe

Part II. In the first part of this article in the March issue, the author discussed the various kinds of threads that can be cut on a standard lathe. In this second part, he describes the exact procedure involved in thread cutting. A third and final part will describe the cutting of special types of threads

By CARL THOMAS

HAVING considered the various types of threads, we will now turn our attention to the actual procedure involved in cutting threads. This is not difficult if one knows how to go about it and what precautions to observe. Incidentally, thread cutting is one of the most interesting of all lathe operations.

When preparing a piece of work for threading first turn down the portion of the work to be threaded to the exact major diameter of the desired thread. A beginner may find it helpful to turn a groove at each end of the portion to be threaded to the exact minor diameter of the thread. Fig. 4 (Part I) will give the depth of thread, or the amount of movement of the compound feed required for cutting the minor diameter grooves when the compound feed is set on the 29 deg angle used for thread cutting. The minor diameter grooves simplify practice thread cutting for the beginner because when the tool point has cut to the depth of the starting groove the thread has been completed. The finishing groove permits the work to revolve freely at the end of each cut. These grooves can be omitted as soon as the beginner has become somewhat familiar with threading practice.

PRACTICAL ENGINEER SECTION

When cutting external threads the compound rest should be set at an angle of 29 deg toward the headstock, as shown in Fig. 3 (Part I.) This will permit the chip to curl out of the way better than if the tool is fed straight in. Then mount the tool holder in the tool post so that the point of the tool is exactly on the lathe center line and

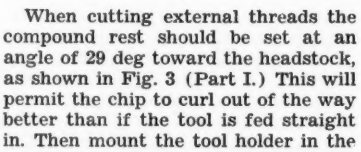


Fig. 15. Setting tool bit

at an exact right angle to the work. A center gage should be used in adjusting the cutter bit, as shown in Fig. 15. Tap lightly on the back of the tool holder when moving it into position. A piece of white paper placed beneath the center gage will show the fit of the tool in the Vee of the gage more plainly. When the tool point has been adjusted to an exact right angle with the work, and it is on exact center line, tighten the tool post screw.

Before starting the cutting operation, check the change gear assembly and the direction of carriage feed. See that the proper change gears are in place and that the carriage feeds toward the headstock. Then set the

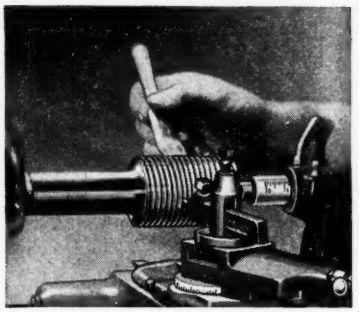


Fig. 16. A small paint brush is excellent for applying oil when cutting external threads. (Photo, South Bend Lathe Works)

compound rest at about the center of its ways and advance the cross feed so that with the tool close to the work the micrometer collar is at zero. Then move the point of the tool about an inch to the right of the start of the thread and advance the tool with the compound rest so that the first cut will be approximately 3 thousandths of an inch deep.

Now start the lathe and engage the carriage feed. The 29 deg angle of the compound rest should permit the trailing edge of the tool to take a fine chasing cut on the finished side of the thread while the leading or cutting edge does the thread forming work.

Some operators consider it advisable to take only a light trial cut for the first cut, just deep enough to scribe a line on the surface of the work. By checking this scribed line with a scale it can be determined whether or not the lathe is arranged for cutting the pitch of threads desired.

When cutting threads in steel, in order to produce a smooth thread, lard oil, cutting compound or machine oil should be applied liberally preceding each cut. A small paint brush is excellent for applying the oil when cutting external threads, as shown in

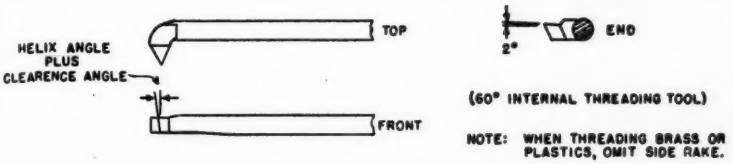


Fig. 17. Type of tool used for cutting 60 deg American National screw threads

Fig. 16. If lubricant is not used, a very rough finish wil result due to tearing of the steel by the cutting tool. When metals other than steel are being threaded, use the type of lubricant recommended for general turning.

When the point of the threading tool reaches the finishing groove at the end of the thread disengage the carriage feed, back out the cross feed two turns, and return the carriage to the starting point by hand. Advance the cross feed again to its original position at zero (two turns) and advance the compound rest for the desired depth of cut. Then engage the carriage feed and start the second cut. Follow this routine on all suceeding cuts. Use only the compound rest feed in regulating depth of cuts. In order to cut threads in this manner a threading dial is necessary, as will be explained later.

The first two or three cuts should not exceed 5 thousandths of an inch each. The cuts following this should be gradually reduced until they are only one, or even one-half, thousandth. Then the cutter bit should be allowed to travel through the thread with no advance at all to clean up any remaining high spots.

The last cuts in threading should be taken with extreme care. If soft metals such as aluminum or brass are being threaded, heavier cuts may be taken than for steel, but for a fine finish, be sure to make the last cuts very light.

It is advisable for the beginner to use the lowest lathe speed obtainable when cutting threads. This allows sufficient time to engage and disengage the carriage travel. When more experience has been gained in thread cutting, higher speeds may be used up to approximately ⅓ or ½ the recommended speeds for turning the various materials.

The finished thread may be checked with a nut of the same thread. The nut should fit snugly without play but should not bind on the thread at any point. Be sure the thread is a proper fit and not merely touching at only a few points.

Whenever possible a groove should be cut at the finish end of the thread to provide clearance, since it is difficult to stop the threading tool abruptly.

Left hand threads are cut in the same way as right hand threads, except that the direction of feed is toward the tailstock and the clearance angles and side rake should be opposite of those shown in Fig. 14 (Part I). When cutting left hand 60 deg type threads, the compound rest should be set at 29 deg in the opposite direction to that shown in Fig. 3 (Part I) (pointed toward the tailstock instead of the headstock as when cutting right hand threads).

Some lathes are equipped with a threading dial. This device, which is attached to the carriage and driven by the lead screw, indicates the proper time to engage the carriage feed so that the cutting tool will enter the same groove of the thread for each cut. If a threading dial is not part of the lathe equipment it will be necessary to reverse the motor drive at the end of each cut, back out the threading tool, and feed the tool out of the thread. This method is cumbersome and little used except when cutting metric and special fractional threads.

Threading dials are made in different styles. On one type, having four marks on the dial, two of the marks numbered (1 and 2). When cutting an even-numbered thread, the carriage feed should be engaged for the first cut when the stationary mark outside the threading dial is in line with any one of the four marks on the rotating portion of the dial. Any one of the four dial marks may then be used for following cuts.

When cutting an odd-numbered thread, engage the carriage feed for the first cut when the stationary mark is in line with either No. 1 or No. 2 mark on the threading dial. Either the No. 1 or No. 2 mark may be used for following cuts.

When cutting half-numbered threads, engage the carriage feed at the same mark on the threading dial for each cut.

On another type of threading dial, with eight marks on the dial, four of the marks numbered (1, 2, 3 and 4), when cutting an even-numbered thread, engage the carriage feed at any line on the dial. For cutting odd-numbered threads, the carriage feed may be engaged at any of the numbered lines on the dial. When cutting half-numbered threads, engage the carriage feed at either of the odd-numbered lines on the dial. If quarter or eighth threads are to be cut, engage the carriage feed at the original starting point on the dial for each cut.

The threading dial cannot be used with transposing gears for cutting metric threads.

Certain precautions should be observed in cutting threads if difficulties and disappointments are to be avoided. Never disengage the carriage feed in the middle of the thread without first backing out the tool with the cross feed. Do not shift the feed reverse lever until the thread is completed. Never remove work held in a chuck until the thread is finished. Where work is held between centers for threading, if the work must be removed for any reason be sure to replace it with the tail of the lathe dog in the same slot of the face plate as before. When turning a long heavy thread, considerable heat may be generated. This will cause the work to expand. Where the work is mounted between centers, the lathe should be stopped at regular intervals and the tightness of the work against the centers checked. After making such a check, the next cut should be a light one because the work may have shifted a little in relation to the position of the tool bit. Whenever the cutter bit shows a tendency to "hog in", check the tool clearance.

Fig. 17 shows the type of tool that is used for cutting internal 60 deg American National screw threads. The angles shown in the figure are

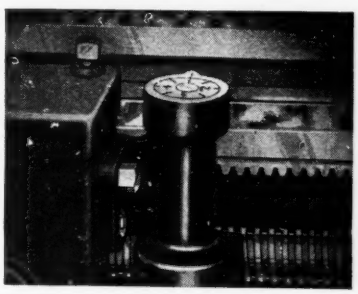


Fig. 18. Threading dial. (Photo, South Bend Lathe Works)

12 per inch and holes as small as ⅝ inch in diameter. The point is ground to 60 deg and is provided with a slight side rake as shown. It is much more important to have plenty of front and side clearance with an internal threading tool than with a boring tool. The point of the threading tool is set exactly on the center line of he work.

Work to be threaded internally is prepared similarily to work that is to be threaded externally. The exact minor diameter is first bored. For beginners it is advisable to bore a groove to the depth of the exact major diameter at the start and finish of the threads, just as was suggested for external threading.

When the thread is to be cut with a 60 deg sharp pointed tool, the major diameter is equal to the minor diameter plus the double depth of

PRACTICAL ENGINEER SECTION

thread, as given in Fig. 4 (Part I). But if the tool bit used is formed to cut exact American National threads, the correct major diameter is given in Fig. 5 or Fig. 6 (Part I).

When the tool has cut to the depth of the groove at the starting end of the thread, the thread is finished. If the thread is being cut to fit a certain screw, the groove at the beginning of the thread is not necessary as the proper depth will be reached when the screw fits the thread correctly. The groove at the finishing end of the thread should be about twice as wide as the thread pitch, and is better if made a few thousandths larger than the major diameter. This groove will then provide a brief interval at the end of each cut during which the carriage feed is still engaged. Of course, after the beginner has gained sufficient experience in internal thread cutting these grooves can be omitted.

When cutting internal threads, the operations are the same as for external threading except that the 29 deg angle of the compound rest is set in the opposite direction to that for external threads. Also it must be remembered that the compound rest feed is toward the operator instead of toward the work, and the cross feed must be advanced to clear the work rather than backed off as in external threading.

In adjusting the threading tool for internal threading be sure to set it exactly at right angles to the work. This may be done wih the aid of the center gage. If the work is machined on the end and the end is at exact right angles to the longitudinal axis, a machinist's steel square may be used to provide an accurate rest for the center gage. Otherwise the center gage may rest against the inside wall of the work, the outside wall, or a steel scale placed against the inside or outside wall of the work, if these surfaces are accurately machined. It is also important to allow sufficient clearance between the tool and the inside diameter of the hole to permit backing the tool out of the thread when the end of the cut has been reached. Of course, the greater rigidity the tool possesses the better. For this reason it should be as large in diameter and as short as possible to prevent springing. A boring bar is therefore better than a boring tool, where the bar can be used. Internal cuts should be lighter than external cuts due to the spring of the tool, and when using a threading tool they should be even lighter than when using a bar.

Note: This is the second of a three-part article on this subject by the author. A third and final installment will appear in the next issue.

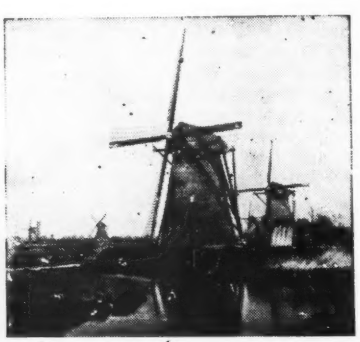
LETTERS AND COMMENTS

WIND-MILL PUMPING STATIONS IN HOLLAND

AS A DENSELY populated country, Holland was always compelled to increase its agricultural capacity. As a result, it became common practice to turn lakes into fertile soil.

The wind-mill power required was retained to keep the "polders dry". (This refers to the removal of 'bilge water" resulting from rainfall and unavoidable leakage.) The system has proved its usefulness, but the exploitation of the several pumping stations and maintenance of the surrounding dikes forms a financial burden on the back of the farmer community. This has sometimes led to a penny - wise, pound - foolish policy, negatively supported by influential central station corporations.

In one instance, a local Board of Control, in one of the northern districts, recommended that an efficient wind-mill pumping station be erected. This advice was neglected in behalf of the provincial central station's load factor.



Another similar situation has recently been pushed to the front. In the vicinity of the city of Rotterdam, a set of wind-mill installations has been draining the Kinderdyke Polder since the enterprise was started. Gradually their number has been decreased from 19 to 8. (The total number in this country has decreased from 7000 to 1350 since 1900.) The remaining units are still driving the old, low-head, scoop wheels and are grouped in series in order to make up for high-head pumping machinery.

The writer visited the installation in 1923 when all the mills were in operation; they presented a great sight. Since then, the mills were partly replaced by central station power. The current was not bought wholesale, nor according to the Hopkinson rate system, but simply per kilowatt.

As time goes by, the file of veterans will undoubtedly be reduced again and again. Electrification offers a relatively cheap immediate solution, but not in the long run. When it comes to sound business principles, the problem should be solved by replacing the scoop-wheels with high-head modern pumping machinery, if it were not for the initial cost.

In order to save this unique old power plant for the near future, the next and logical step would be the creation of a slow-speed engine as a stand-by power plant. This would be a combination of a modern wind-mill and internal combustion engine. This would mean a yearly sixty days relief period for the engine and a cut of 16 per cent in the fuel consumption. Zaandam, Holland. H. WEILLAND LOS

POINTERS ON THE GAS CONSTANT

THE ARTICLE on "Flow of Fluids" by Hynes in the January issue of POWER GENERATION is very interesting and timely. Of particular interest is the consideration given to Reynolds number and its application.

With the permission of the editor and the author, I would like to pass on to the readers some pointers on the gas constant "R" in Equation VI, and the perfect gas law.

$$PV = wRT \quad \ldots\ldots 1$$

This equation can be written $P = \frac{V}{w} = RT$. Replacing the term V/w by by V, vee barred, specific volume in cu ft per lb, the perfect gas law becomes $PV = RT$, or

$$\frac{PV}{T} = R \quad \ldots\ldots 2$$

The PV product is the expression of work in ft. lb. Hence "R" is the value of the work done in heating a gas 1 F in 1 ft. lb. per deg F.

While this law applies to perfect gases, it is also applicable to air, with certain transgressions. It also applies to steam, particularly, superheated steam, the steam "gas". According to the definition given in POWER PLANT ENGINEERING, November, 1947, steam is "hot air soaked in water". What is the value of "R" for steam or any gas?

$$R = \frac{B}{M} \quad \ldots\ldots 3$$

where: R—as defined before
B—universal gas constant, 1545.
M—the molecular weight of the gas.

The gases which are most familiar to the diesel engineer are nitrogen, N_2, and carbon dioxide, CO_2. The molecular weight of N_2 is 2 x 14 or

28. Therefore, the gas constant "R" for this gas is 1545/28 or 55.2. The molecular weight of CO_2 is 12 plus 2 x 16 or 44; "R" for this gas is then 1545/44 or 35.1.

Air is a mixture of 76.85 per cent nitrogen and 23.15 per cent oxygen. Its molecular weight is the sum of 0.7685 x 28 and 0.2315 x 32, or 21.53 plus 7.39, or 28.92. The gas constant "R" for air is 1545/28.92 or 53.4.

The molecular weight of steam, H_2O, is 2 x 1 plus 16, or 18. "R" for steam is 1545/18 or 85.8, in round figures. PV equals 53.4T for air, and PV equals 85.8T for steam—"air soaked in water". Philadelphia, Pa.

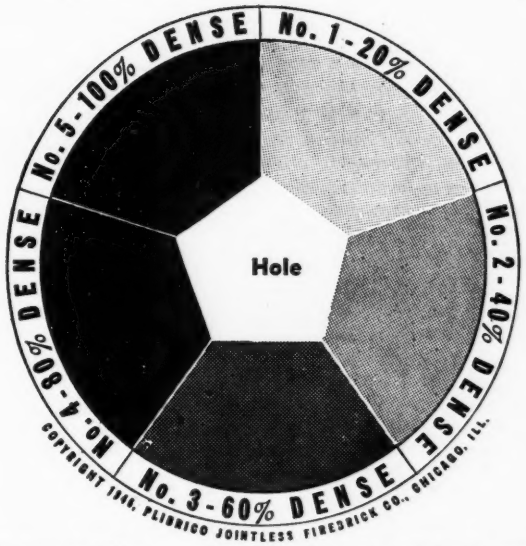
JACOB YAVITCH, M.M.E.

NEW SMOKE CHART IN CONVENIENT FORM

BECAUSE of the present activity and interest in smoke abatement, and the necessity for every power engineer to do everything possible to prevent smoke and dirt emission from stacks, a new form of smoke chart designed for convenient use has recently been announced. It is shown in the accompanying illustration.

This chart employs the standard Ringlemann smoke ratings—No. 1 to No. 5 smoke—but in a design employing finer shadings than some other charts have used and designed to give greatest convenience in using it.

New Ringelmann-type smoke chart, actual size as printed on heavy card 3½ in. by 8½ in. with instructions for use



Now that the war is over, existing smoke ordinances are being tightened, new ordinances being adopted; most of these are based on smoke densities as measured by the Ringlemann standards. The standard Ringlemann smoke charts, are, of course, those originally published by the U. S. Bureau of Mines. These, however, are on large sheets of paper, which must usually be mounted 50 or even 100 ft from the observer so that the cross-hatchings on the chart will run together and look like a shade of gray, with which the smoke can be compared. Sometimes physical conditions make it difficult to use these. Other versions of the standard Ringlemann charts with cross-hatching have been made on smaller cards, but even these must be set 15 to 20 ft from the eye to give a gray tone.

The chart shown here has been designed to overcome these difficulties by reproducing the correct tones of gray directly, to correspond with the various Ringelmann classifications and furthermore, to be held by the observer at arms' length so it can be used most conveniently. The chart was worked out with the assistance of Frank A. Chambers, smoke inspector of the City of Chicago, in cooperation with Plibrico Jointless Firebrick Co., which manufactures the charts.

The chart, as shown in full size in the illustration, is printed on a suitable card, the impression being backed with black on the opposite side of the card to prevent light transmission. To use it, simply hold the card at arms' length and look through the hole at the smoke to be measured, comparing it with the corresponding shades around the hole.

A copy of the chart will be sent to any reader who cares to ask for it. Write to Editorial Department, POWER GENERATION, 53 West Jackson Blvd., Chicago 4, Illinois.

Important Note: Do not try to use this chart reproduction, because light transmitted through the paper causes inaccurate readings. Instead, write the Editors for copies of the original chart.

HOW TO SELECT AND APPLY CENTRIFUGAL PUMPS—CORRECTION

IT HAS BEEN called to our attention that there are 125 feet of straight pipe in the discharge line of Fig. 2 on page 74 of the January issue of POWER GENERATION instead of the 105 ft. given. This will change the discharge head, H_d, to 164 ft. and of course, affect the other calculations accordingly. The friction head in the discharge line is:

$$H_{fd} = \frac{164}{100} (38) = 62.32 \text{ ft, not } 54.6 \text{ ft}$$

Total dynamic head should then be 127:52 ft., not 119.80 ft. From Table III, a pump of the type LE-5 should be used, not an LD-6. Will the readers please make these corrections in their copies of the January issue?

—The Editor.

FLOW OF FLUIDS —CORRECTIONS

THE FIGURES 1.85 and 4.97 are the exponents of "a" and "d" respectively, in Fritzche's formula on page 80 of the January issue of POWER GENERATION and not multipliers. Please make this correction in your copy of the January issue.—The Editor.

OVERFIRE AIR LICKED THIS SMOKE PROBLEM

By H. B. McDermid

Fig. 1. Sectional view of Dutch oven taken 1 foot below ceiling showing position of the ports and steam jets

WHILE THE FACTS concerning smoke prevention in boiler furnaces are well known among combustion engineers, they are still a complete mystery to many operating engineers and firemen who have had to get information the hard way, who find usually that there are not too many obliging instructors in the "University of Hard Knocks." Some of them may be interested in how one engineer solved the problem in a plant which certainly was not above the average in equipment, and which was far out of the ordinary in bad load conditions.

Into this particular plant, which was already plagued to the breaking point with poorly chosen, though fairly good equipment, had it been correctly set up with well matched units, came the smoke inspector, threatening dire punishment if the smoke was not abated instantly, or sooner. The plant manager neatly sidestepped, figuring if he paid for a consulting engineer's services (?), with nobody at all to check his work, that he had done all there was to do in getting a suitable power plant. It turned out that he was at the end of his troubles—only it was the wrong end.

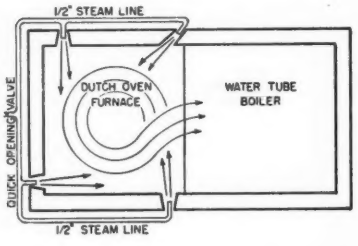
Eventually it was up to the power plant engineer to improve conditions as best he could. There were two water tube boilers, loaded to 250 per cent of their rating, burning wood waste, which was automatically fed as made by the mill, in Dutch oven furnaces. This was supplemented by

hand fired coal to make the necessary heat for the load carried.

The fireman was a dandy. He was picked from forty men who had tried the job and failed to handle it for one reason or another. The poor fellow was nearly frantic with the continuous struggle; even he had been known to lose the load two or three times.

The one helpful thing that is recognized as an important factor in keeping smoke under control, handling only a reasonable load, was out of the picture in this case. It was finally decided to introduce overfire air, with as much turbulence as possible, to see what results could be secured with the severe problem to be faced and whipped, if possible.

The Dutch oven ceiling was approximately 54 in. above the grates of the furnace. This did not leave a great deal of room for combustion to be completed after a good thick fire was in place. Ports were cut in the four corners, smoothly plastered to a funnel shape, with the large end toward the inside, as shown in Fig. 1. Steam was then led to each opening through ½ in. pipes; all four



openings were controlled by a single quick opening valve, placed in the handiest location for the fireman.

It was hoped that when the steam jets, placed in the four funnels in the corners of the furnace, were turned on, they would induce an air flow which would not only introduce the necessary extra air to complete the combustion of the carbon in the smoke, but would also generate a turbulence in the furnace gases. This would intimately mix the incoming oxygen of the air with the carbon, and so, by making a good mechanical mixture of the two, would produce a much more nearly complete combustion.

This proved to be the case and the results were most gratifying. An observer could stand outside the boiler room door where he could see both the fireman and the top of the stack, and watch a fire put in. He could see the smoke come rolling out, as black as coal could make it. Then he could watch the fireman flip his steam valve and a few seconds later see the black smoke wiped off the top of the stack as if it had been wiped off with a straight edge.

It was feared that with the heavy load conditions that prevailed, the steaming abilities of the boilers would be cut down, by so much overfire air. However, with the boiler overloaded as was, no deletorious effects could be detected.

So, again, another condition was proven susceptible to good smoke control. The only drawback was that the fireman got too lazy to flip on his steam valve after throwing in a coal fire, or else he just loved to see the black smoke roll. Finally the engineer had to rig up a mirror in the yard, so he could see the top of the stack from his usual work station, and so keep tab on the smoke conditions.

Questions And Answers

Question No. 413

WHAT METHODS KEEP POWER PLANTS CLEAN?

IN ORDER to improve the safety of coal-burning power plants, as well as working conditions and general cleanlines of the plant, particularly in the boiler house, operators would appreciate a discussion of methods and provisions that have proved effective in helping to keep a plant clean. What information can Q & A readers offer on this subject?

Chicago, Ill. E. R. C.

Answer No. 399

SHOULD 115-VOLT EXTENSION LIGHTS BE USED INSIDE BOILER DRUMS?

IN THE NOVEMBER, 1947, issue, R. H. N. stated that he has always used 30 to 32 v for extension lights inside boiler drums and other damp or wet places in boiler, or any similar situation around the plant, during inspection or repairs. However, he says that in a new plant his company is building, the electricians and electrical engineers are recommending 115 v for this purpose, but that he does not agree with them.

He wanted comments from readers on the proper voltage to use, also information as to any rules and regulations in the ASME Boiler Code or the National Safety Codes.

Several engineers have expressed the general opinion that, of course, the lower voltages were much more conducive to safety. Others have discussed the various factors and conditions that will affect electric shock at 115 v or even at the lower voltages. The general opinion, on the whole, seems to be that there is a tendency to use the lower voltages today. One boiler inspector has stated that while there is no specific provision or mandatory regulation in any of the codes, still there has been considerable discussion of the point by the National Safety Council.

While all this was going on, an issue of *The Firebox* appeared which gives some pretty definite comments on this point. They are from John M. Roche, Director of Industrial Safety, The National Safety Council. In an article entitled, Safety Rules for Boiler and Furnace Work, Mr. Roche first discusses the need for both workers and supervisors to consider safety all the time in working around boilers and furnaces. He then goes on:

"Doing repair work inside boiler furnaces or boilers with faulty electrical equipment all too often leads to fatal shock from circuits of 110 v or less. Although ordinary contact with such circuits may have negligible results because of the high resistance of the dry skin and the limited body area in contact, necessary safety precautions must be observed. Few persons realize that when the resistance is lowered by perspiration, water, or contacts that extend over large areas of the body, the current may be sufficient to cause death.

"One repairman was working on the inside of a water heater by the light of an extension lamp. Water dripped from a leaking valve onto the defective cord, and when the man grasped the cord while standing in water, he received such a shock that he was unable to let go. Before help could be summoned, the repairman was unconscious. It took 10 min to extricate his limp body through the manhole, and by the time he was freed he had died of electrical shock.

"Workers and management alike easily overlook the fact that boilers and furnaces are nearly a perfect ground for electricity, just as the metal hulls of ships, surrounded as they are by water, also present a perfect ground and conductor.

During the war, the National Safety Council was called upon by the shipbuilding industry to study the problem of fatal shock from 110 v circuits. Many of its findings and recommendations are equally applicable to boilers and boiler furnaces, and should be studied carefully by both management and employees.

"The most frequent exposures to low voltage shocks were found to come from the following activities:

1. Replacing light bulbs in brass shell sockets, or removing broken bulbs from any socket while standing on, or making contact with, a grounded surface.

2. Using defective portable hand lamps and extension cords, especially when inside a boiler or tank, or in contact with other grounded surfaces.

3. Using defective portable electric tools, especially when working on grounded surfaces.

4. Repairing electrical tools, cords, or other devices which have not been disconnected from the source of power.

"Distribution lines should be enclosed in grounded metallic conduits or placed where accidental contacts will not occur. All non-current carrying metal parts of electrical equipment should be grounded effectively. This will include frames of motors used for driving stationary equipment, metallic frames of portable hand tools, etc. One of the most convenient and effective methods of grounding is to use a cord or cable containing a third conductor equipped with polarized plugs.

"Extension cords should be of the type listed by Underwriters' Laboratories as approved for the locations and purposes to be served, and they should be inspected regularly. Rubber sheathed cords are the best for portable electric tools and hand lamps. It is important to point out to employees that rubber mats, dry planks, insulating stools, or other insulating devices should be used when they are working with extension cords in boilers, tanks, furnaces and other grounded areas.

"Rubber, plastic, or porcelain sockets are recommended for pendant lamps. If bronze shell sockets are used, the outer shell should be grounded as effectively as possible. In addition, precautions should be taken to protect the socket insulation against dampness or mechanical damage.

"Non-conductive type sockets, as well as insulating guards and shell coverings, shoud be used with portable hand lamps. All non-current carrying metal parts of portable electric hand tools should be grounded, and the tools kept in good repair. It is important to use insulating devices when working on grounded surfaces.

"For maximum protection, transformers should be used to reduce 110 v circuits to 32 v for portable electric hand tools, since the likelihood of fatal shock is greatly reduced. This should be kept in mind when buying or replacing hand tools. The safest portable hand lamp available also is the low voltage lamp. Through the use of small, portable 110 to 6-v transformers, these lamps can be operated at six volts with maximum safety."

Answer No. 405

WHAT'S THE BEST AIRCRAFT NIGHT WARNING FOR A STACK?

Must Comply with Requirements of CAA Says J. E. S.

A PAIR OF red lamps at the top of the stack as suggested by L.B.E. will not meet the requirements of the Civil Aeronautics Administration. Since details of stack construction were not stated in the question, I cannot recommend a lighting layout for your stack. Generally speaking, each stack will require a different layout. Before engineering work on any job can be laid out and completed, certain necessary details and facts must be known, and this stack lighting job is no exception.

The following facts should be known for this job: 1. Height of stack, 2. Type of construction (round or square), 3. Dimension at top (diameter if round. 4. Chemical analysis of stack gas (of importance if stack is used by a chemical plant).

The Aeronautical Board, Washington, D.C. composed of representatives of U.S. Air Forces, The Bureau of Aeronautics, U.S. Navy Department, and the Civil Aeronautics Administration has concurred to uniform requirements which shall apply to existing and future installations for lighting obstructions to air navigation. A copy of these requirements may be obtained from the Civil Aeronautics Administration in your region.

Some of the requirements which will apply to your job are as follows:

1. Objects in the vicinity of a landing area which have definitely been determined to constitute a hazard shall be marked with red lights.

2. The arrangement and number of obstruction lights shall be such that the obstruction is defined from every angle of Azimuth.

3. Top stack lights shall be placed approximately 6 ft below the top of the stack. When the top of the obstruction is more than 150 ft above the level of the surrounding ground, an additional light will be added for each additional 150 ft or fraction thereof. Additional lights will be equally spaced between the top of stack and ground level.

Stacks are generally equipped with double-multiple obstruction light fixture, with Holophane or Corning Fresonal Red Globes. The Thompson disconnecting and lowering hangers are used on many installations and have given very satisfactory service for the maintenance of lamps and fixtures. The Thompson Electric Co., Cleveland, Ohio, is experienced in this line of work, and offer the public many types of hangers. They manufacture the correct hanger for any job. One type with operating cable only, another with operating and guide cable. Some are hand operated, while others require winch operation. Some jobs may only require that the hangers and fixtures be galvanized, while others may require plating of different materials to resist certain acids which may be in the stack gases.

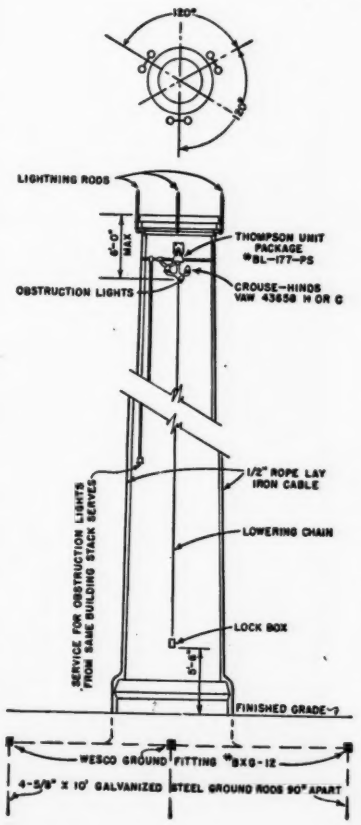
Obstruction light fixtures, a product of two nationally known concerns, can also be obtained from the Thompson Electric Co.

On a round stack, under certain conditions, the CAA will permit the use of three (3) Double-Obstruction lights installed 120 degrees apart. Figures 1 and 2 are typical of many stack installations.

The Thompson Electric Co. is long experienced in this field of work, and if you will send them the more important details of your stack, I am certain that they will be more than glad to engineer your job and specify the correct equipment which will meet all CAA requirements.

Salina, Kansas Joseph E. Sullivant

PRACTICAL ENGINEER SECTION



CUTTING FLUIDS

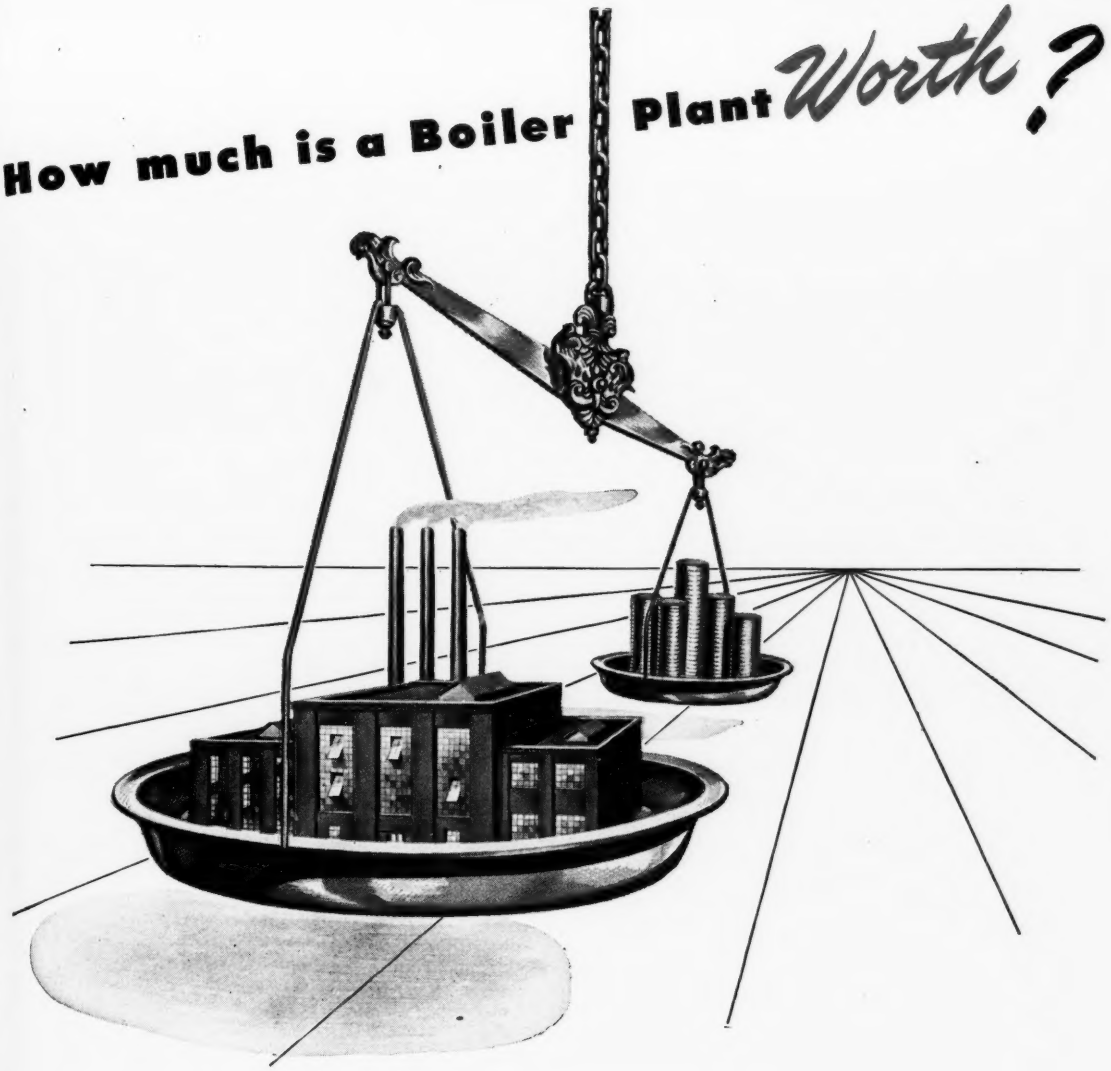
MATERIAL	CUTTING FLUIDS FOR DRILLING	
	ORDER OF DECREASING EFFECTIVENESS	ORDER OF INCREASING EXPENSE
Aluminum & Alloys	Kerosene Kerosene & Lard Oil Soda Water	Soda Water Kerosene Kerosene & Lard Oil
Brass	Dry Kerosene & Min.) Lard Oil) Deep Soda Water) Holes	Dry Soda Water Kerosene & Mineral Lard Oil
Magnesium & Alloys Bronze	Mineral Lard Oil Soda Water (Bronze Only) Dry	Dry Soda Water (Bronze Only) Mineral Lard Oil
Copper	Mineral Lard Oil & Kerosene Soda Water Dry	Dry Soda Water Mineral Lard Oil & Kerosene
Monel Metal Mild Steels Tough Alloy Steels Steel Forgings Cast Steel Wrought Iron	Mineral Lard Oil Sulfurized Oil Soda Water	Soda Water Mineral Lard Oil Sulfurized Oil
Manganese Steel Cast Iron	Dry	Dry
Malleable Iron	Dry Soda Water (Deep Holes)	Dry Soda Water
Tool Steel	Mineral Lard Oil & Kerosene Kerosene Mineral Lard Oil	Mineral Lard Oil Mineral Lard Oil & Kerosene Kerosene
Micarta, Bakelite Fiber, Asbestos, Hard Rubber, Ebony	Dry	Dry

CUTTING FLUIDS FOR MACHINE REAMING	
MATERIAL	ORDER OF DECREASING EFFECTIVENESS
Aluminum & Alloys Magnesium & Alloys	Mineral lard Oil Kerosene Soda water - (Aluminum Only)
Brass and Bronze	Soda Water
Cast Iron	Dry
Cast Steel	Lard Oil Mineral Lard Oil Soda Water
Copper	Lard Oil Soda Water
Malleable Iron	Soda Water Mineral lard Oil
Monel Metal	Lard Oil Soda Water
Mild Steel	Mineral Lard Oil Soda Water
Tough Alloy Steels Steel Forgings	Mineral Lard Oil Sulfurized Oil Soda Water
Steel, Tool	Lard Oil Sulfurized Oil Soda Water
Wrought Iron	Mineral Lard Oil Soda Water
Micarta & Bakelite	Mineral Lard Oil

CUTTING FLUIDS FOR TAPPING	
MATERIAL	ORDER OF DECREASING EFFECTIVENESS
Aluminum Alloys	1/2 Lard Oil and 1/2 Kerosene
Magnesium Alloys	Light Mineral Oil
Brass and Bronze	Light Mineral Oil Dry
Cast Iron	Small amounts of Miner al Lard Oil, Soap, or Tallow
Copper	*"Cresol z-3" & Paraf-fin Oil Sulfurized Oil & Paraffin Oil
Malleable Iron	Sulfurized Oil
Monel Metal	Lard Oil & Kerosene Sulfurized Oil
Wrought Iron Mild Steel	Sulfurized Oil & Paraffin Oil
Tool Steel	Sulfurized Oil Lard Oil & Kerosene
Stainless Steel	Sulfurized Oil
Tough Alloy Steels Cast Steel Steel Forgings	Sulfurized Oil
Rubber, Hard Fiber	Dry
Micarta, Moldarta & Other Molded Plastics	Dry

* "Cresol z-3" is an excellent heat dissipator and does not stain the work. It is rather expensive but may be used in a 10 per cent solution of Paraffin Oil. (Courtesy Westinghouse Electric Corp.)

How much is a Boiler Plant *Worth?*



A boiler plant may *cost* up to any figure you wish to name.

But a boiler plant's *worth* depends entirely upon how efficiently it operates. For instance, how many or *how few* shut-downs you have may depend entirely on the effectiveness of your water conditioning service.

Correct water conditioning is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . . W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

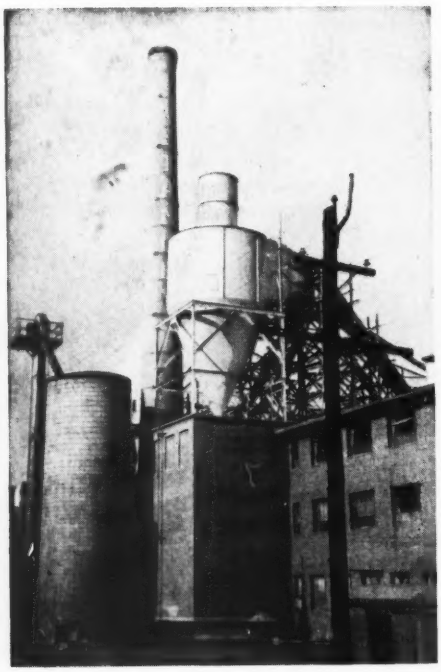


Fig. 9. (Left) View of the completed buildings showing wood vault, coal storage silo, dust collector, etc. Note close grouping of the equipment

Fig. 10. (Above) A photograph of the boiler control panel

POWER PLANT IMPROVEMENT AT STANLEY FURNITURE CO.

(Continued from page 55)

recommended because of its ease of installation and adjustment.

With the exception of setting the forced draft fans and a few incidentals all the equipment described in the foregoing paragraphs was completely installed and tested out by early November, 1947, even to lowering the boiler room floor 16 in. to permit installation of new fronts. The final phase of the work would involve conversion of the typical HRT boiler settings to the design, Fig. 13, recommended by the Iron Fireman Co. It was decided to start work on No. 3 boiler at the time of the regular plant shut down on Friday, November 21. At this time Mr. H. R. Dengate, Engineer for the Iron Fireman Co., the boiler construction crews of the J. J. Bowers Co., Roanoke, Virginia, and metalsmiths from the Wade Sheet Metal Co., Martinsville, Virginia, were all called in and work commenced. By working continuously day and night it was possible to start a slow fire in No. 3 boiler Monday afternoon, November 24, and on Wednesday it went on the line. The factories had started up at the regular time on Monday. Due to removal of one dust collector dust from one factory was being fed to the new cyclone dust collector and stored in the wood vault. Installation of the new small collectors was held up at this time pending removal of the remaining old collector. It will be remembered that these new collectors were to set in the old collector steel framework. On Wednesday, November 26, the plant shut down for the regular Thanksgiving holidays and during this period the work on the remaining boilers was completed. In order to allow the furnaces more time in which to bake out Factory No. 1 machine room wasn't started on Monday, Dec. 1. On this date partial conversion to automatic operation was effected, the final and complete conversion occuring on Tuesday. Thus throughout the entire construction program only eight hours production time from one machine room was lost. The change-over involved some degree of confusion that was quickly ironed out. The only operational difficulty encountered was a series of mishaps on the mesh conveyor. The type of conveyor belt used and the method used was experimental, being tried out at the Stanley Furniture Co. for the first time. The many and varied difficulties encountered trying to satisfactorily remove the dust from the wood vault are too numerous to discuss in this article. In general the following suggestions are offered. Never fill the wood vault and then start the conveyor. Try to fill the vault with the conveyor in operation and thus establish a flow of fuel. Be sure that the flow of fuel will, in no manner, interfere with the flow of air that conveys the fuel. If a vibrator is used on a hopper in the manner described in this article operate it momentarily to start the fuel flow. Never allow it to operate for any length of time or serious packing conditions will result. Completion of the new installation involved an additional loading of 130 hp on the plant generating facilities.

The power generating equipment consists of a Chuse engine driving a 575 V, 3 phase, 60 cycle, 452 amp, 150 rpm, 450 kva, 0.8 PF, Cont 50 C rise alternator and a 29 by 36 in. right hand, side crank Universal Unaflow Skinner Engine, direct connected to a

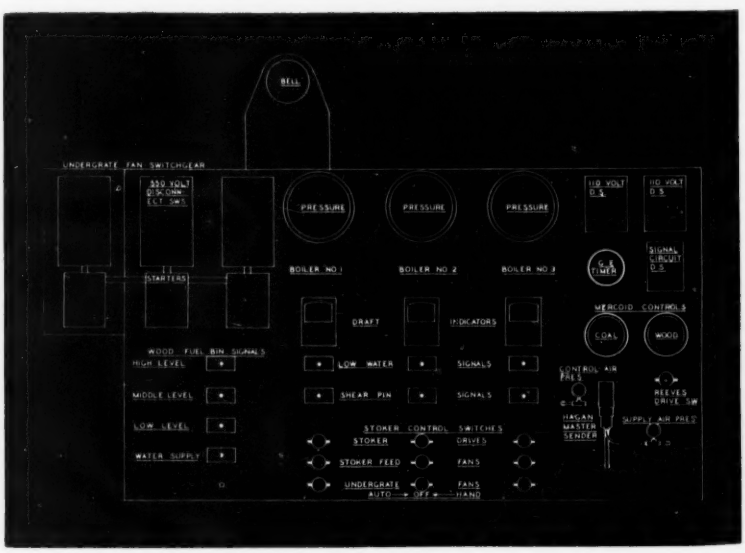
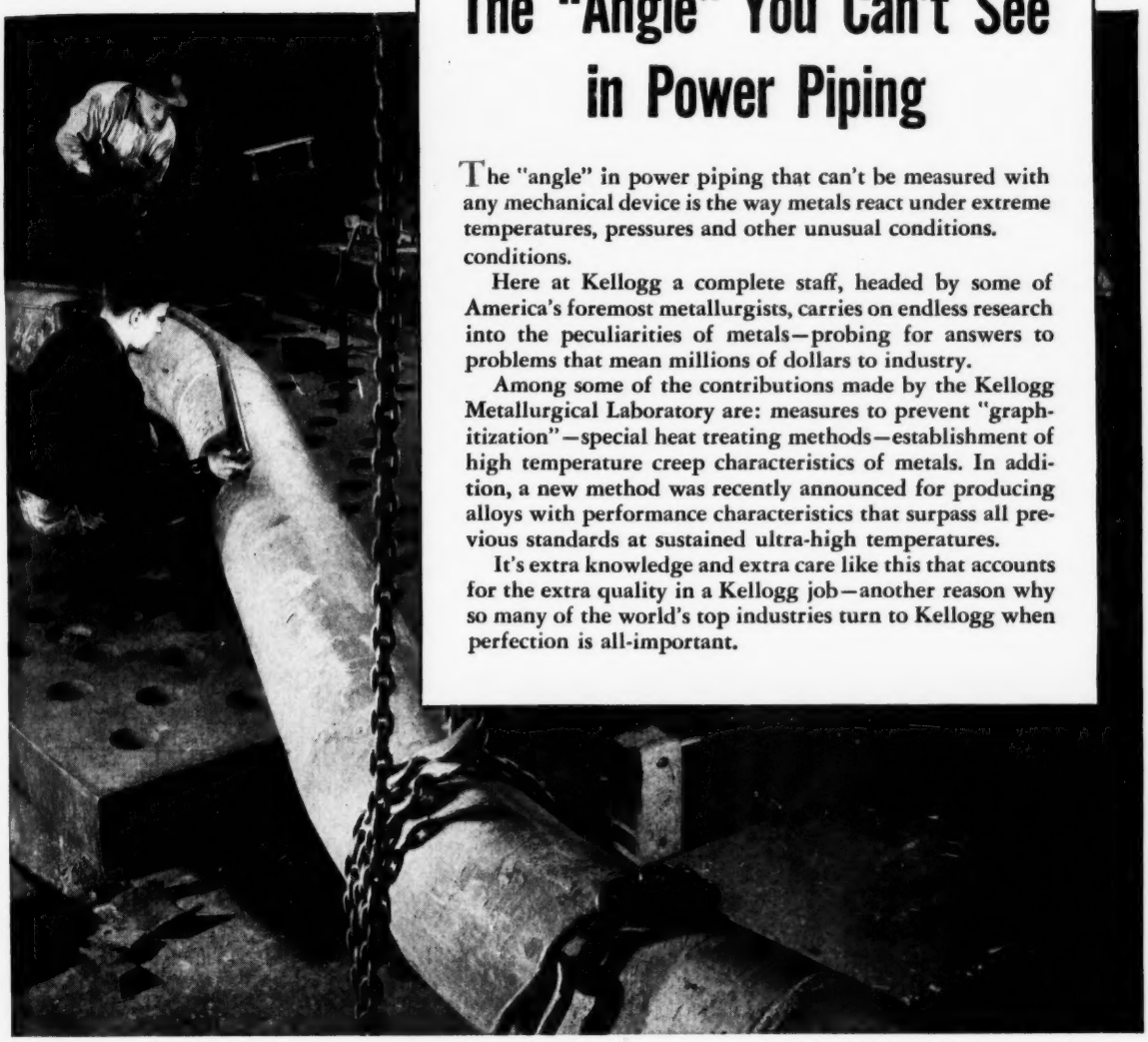


Fig. 11. Arrangement of instruments on boiler control panel



The "Angle" You Can't See in Power Piping

The "angle" in power piping that can't be measured with any mechanical device is the way metals react under extreme temperatures, pressures and other unusual conditions. conditions.

Here at Kellogg a complete staff, headed by some of America's foremost metallurgists, carries on endless research into the peculiarities of metals—probing for answers to problems that mean millions of dollars to industry.

Among some of the contributions made by the Kellogg Metallurgical Laboratory are: measures to prevent "graphitization"—special heat treating methods—establishment of high temperature creep characteristics of metals. In addition, a new method was recently announced for producing alloys with performance characteristics that surpass all previous standards at sustained ultra-high temperatures.

It's extra knowledge and extra care like this that accounts for the extra quality in a Kellogg job—another reason why so many of the world's top industries turn to Kellogg when perfection is all-important.

FABRICATED PRODUCTS DIVISION

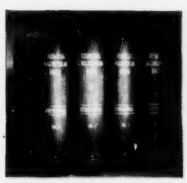
THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INC.

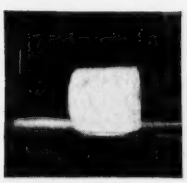
NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
TULSA • HOUSTON • TORONTO • LONDON • PARIS

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING
PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.



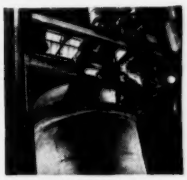
Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.



Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

750 kva, 600-kw, 0.8 pf, 50 C rise, 3-phase, 60-cycle, 600 v, 150 rpm G-E alternator. This alternator was at times seriously overloaded. It is rated at 723 amp and quite frequently carried 1000 amps and over with about 60 per cent pf. Stator temperature was about 220 F. To correct this undesirable condition static condensers were recommended and purchased having a total rating of 345 kvar. Five condensers of 5 kvar were individually installed on five 20 hp motors driving blowers in the dry kilns. One 20 kvar condenser was installed on a 75 hp mill exhauster located in factory No 2. A 15 kvar condenser was connected to the 60 hp hog motor. Another 15 kvar condenser remains to be installed on the 60 hp motor driving factory No. 1 mill exhauster. The remaining 270 kvar in 15 kvar units in three cabinets of 90 kvar each were installed above the bus bars on the main generator control and distribution panels. These units were con nected through a vacant circuit break er to the bus bars. Despite the additional 130 hp that was added the generator now pulls the entire plant load with a pf of 90 per cent or better, a typical loading being: 700 amp, 600 v, 90 per cent pf, and 650 kw.

The cost of the power plant improvements described in the foregoing paragraphs is approximately as follows: Wood Vault $6068; Wood Pulverizer with Control $4031.14; Wood Pulverizer Pit $1147.00; Dust Handling System $15,000; Coal Handling Equipment and Combustion Control $19,000; Coal Silo $3525; Coal Unloader $612.40; Bucket Elevator $2100; Boiler Work $11,273; Condensers $2555.84. The total costs were about $65,000 but actually the figure will run nearer $70,000 when allowing for labor and other factors difficult to account for.

The Stanley Furniture Co. formerly used an average of 20 cars of coal a year which at the present time would mean an expenditure of approximately $10,000 a year. Power Costs approximated $700 a month. Efficiency tests on the new installation are difficult to run because of lack of proper equipment. Operational results to date indicate that the power plant can be operated entirely on waste wood even in the dead of winter. Coal will then be used only in case of emergency or on week ends when the supply of wood waste is exhausted. Thus the entire costs of the power plant improvement should be mitigated in a few years.

Much credit is due Thos. B. Stanley, Company President, and G. R. Holsclaw, Plant Superintendent, for proper selection of equipment and for helpful judgment that enabled the successful completion of the construction program. Much credit also goes to H. N Wright, Ass't Treasurer, whose advice and wholehearted efforts to maintain a steady flow of materials were invaluable. The cooperation of the Plant Maintenance Force and their willingness to pitch in wherever necessary cannot be praised too highly.

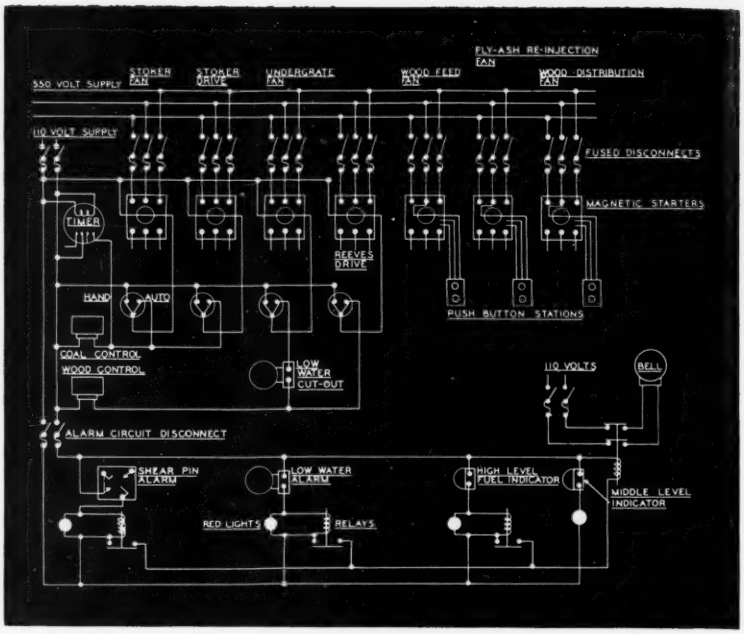


Fig. 12. Wiring diagram of the electrical equipment. Stokers can be operated manually or automatically

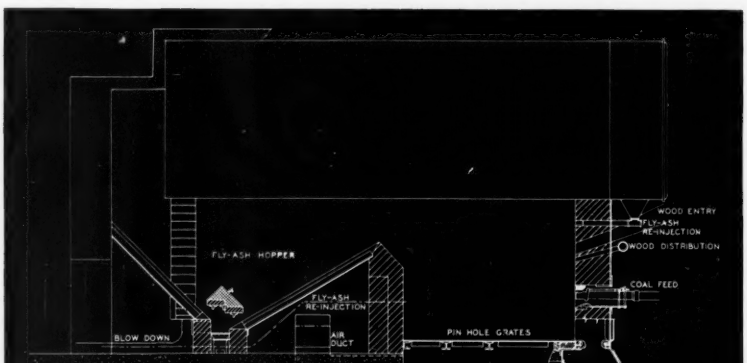


Fig. 13. Details of the boiler setting. This drawing shows the coal feed and the wood feed above it.

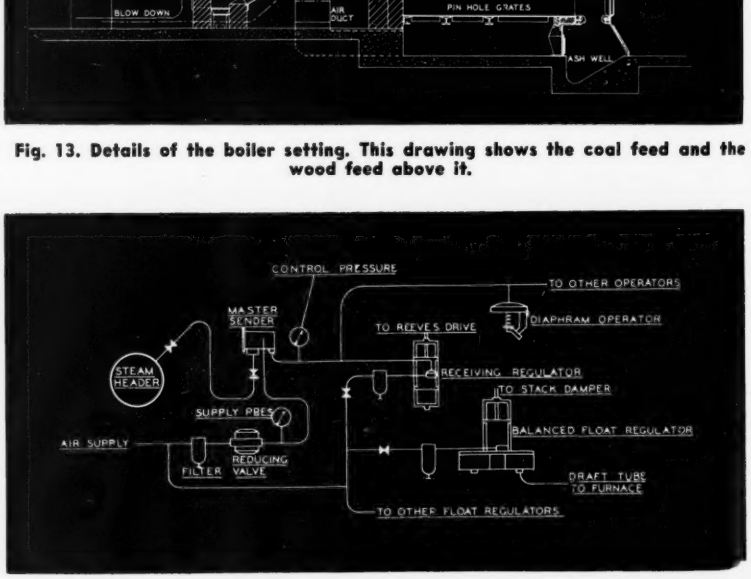


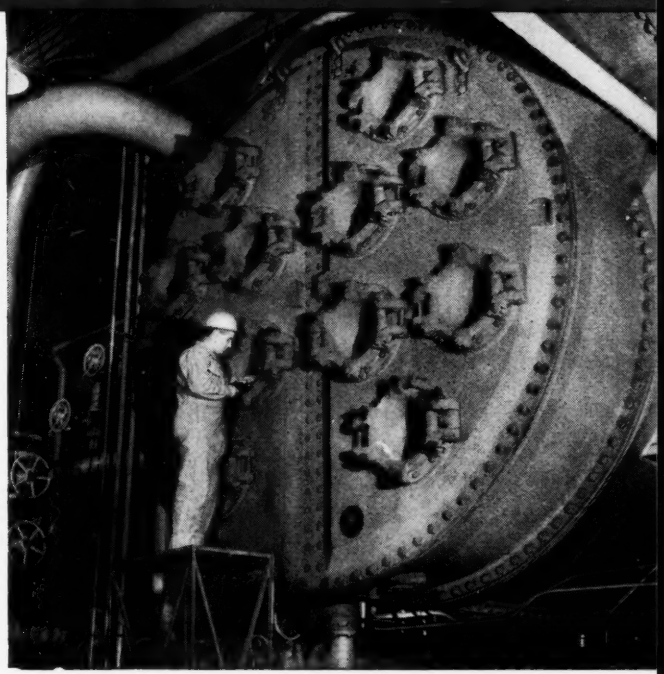
Fig. 14. The Hagan combustion control system. Balanced float regulator controls furnace draft by positioning stack damper

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

clean condensers rapidly—

the chemical way!



Engineers responsible for power plants in many industries know that *clean* condensers and boilers are important factors in *keeping down costs.*

To help you keep down costs and maintain designed operating efficiency in many types of heat exchange equipment, Dowell offers a fast, reliable chemical scale removal service which has been proved in thousands of successful cleaning jobs.

Dowell engineers fill the equipment with liquid solvents designed to dissolve and disintegrate the scale and sludge deposits which retard heat transfer. Dismantling is unnecessary; down time is reduced to a minimum.

Dowell engineers are experienced, know which solvents to use, and have the necessary equipment—special truck-mounted tanks, pumps, heaters and chemical proportioners—to make possible control of each stage of the job.

To clean condensers, boilers, many other types of heat-exchange equipment, water lines and water wells—call Dowell. Ask for literature and a prompt estimate on *your* job.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

New York	Buffalo	Wichita	Mt. Pleasant, Mich.
Boston	Cleveland	Oklahoma City	Hamilton, Ohio
Philadelphia	Pittsburgh	Houston	Charleston, W. Va.
Baltimore	Detroit	New Orleans	Salem, Illinois
Wilmington	Chicago	Baton Rouge	Borger, Texas
Richmond	St. Louis	Ft. Worth	Wichita Falls, Tex.
Jacksonville	Kansas City	Shreveport	Lafayette, La.

Long Beach, Casper: Dowell Associate—International Cementers, Inc.

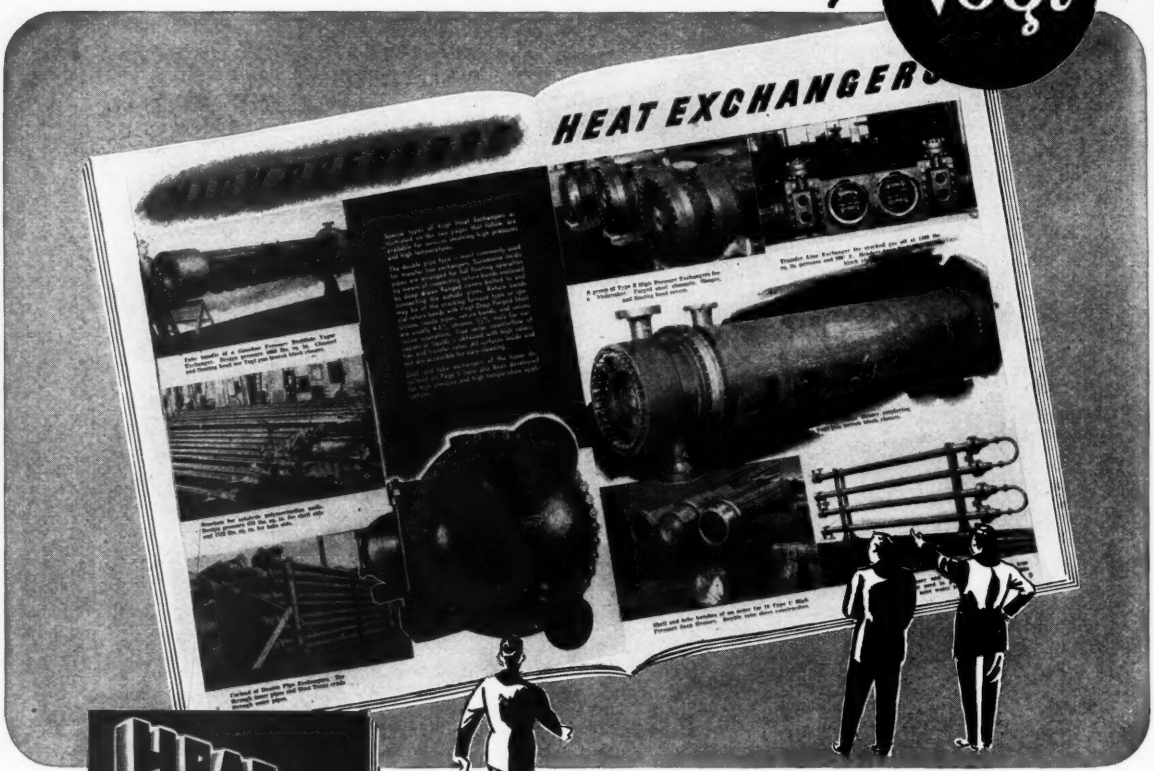
DOWELL

A SERVICE ORGANIZATION

Presenting

a pictorial record of standard and special built HEAT TRANSFER EQUIPMENT

by Vogt



Write for a copy of Bulletin HE-5, on your letterhead.

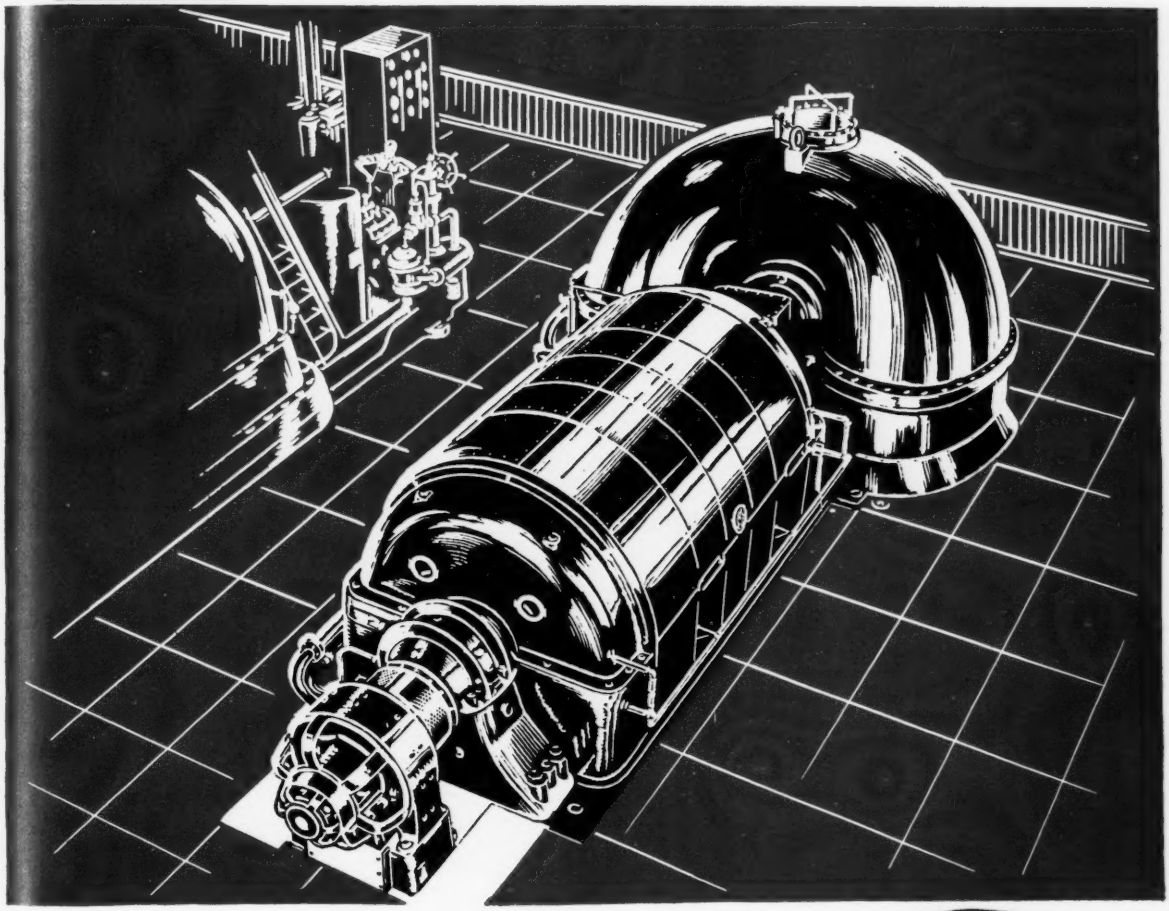
You are invited to send for this record of ingenuity in heat exchanger design and construction.

Shown, among examples of the many types we build, are units for diversified applications, high pressures, and special operating conditions as well as conventional types for ordinary exchanger services in petroleum refineries, chemical plants, process industries, power plants, etc.

Thousands of installations in successful operation attest to Vogt's ability to give effective help in the solution of heat transfer problems peculiar to a wide variety of operating conditions.

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE 10, KENTUCKY
BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

YES! Tycol Aturbrio Turbine Oils perform better . . . BETTER . . . BETTER



Tycol Aturbrio Turbine Oils perform better because:

. . . *Tycol Aturbrio Oils* provide positive protection against oxidation with maximum lubrication efficiency.

. . . *Tycol Aturbrio Oils* provide maximum resistance to sludging and emulsification.

. . . *Tycol Aturbrio Oils* have a purity of refinement . . . service endurance . . . high rust and oxidation inhibiting qualities that combine to make an ideal turbine lubricant.

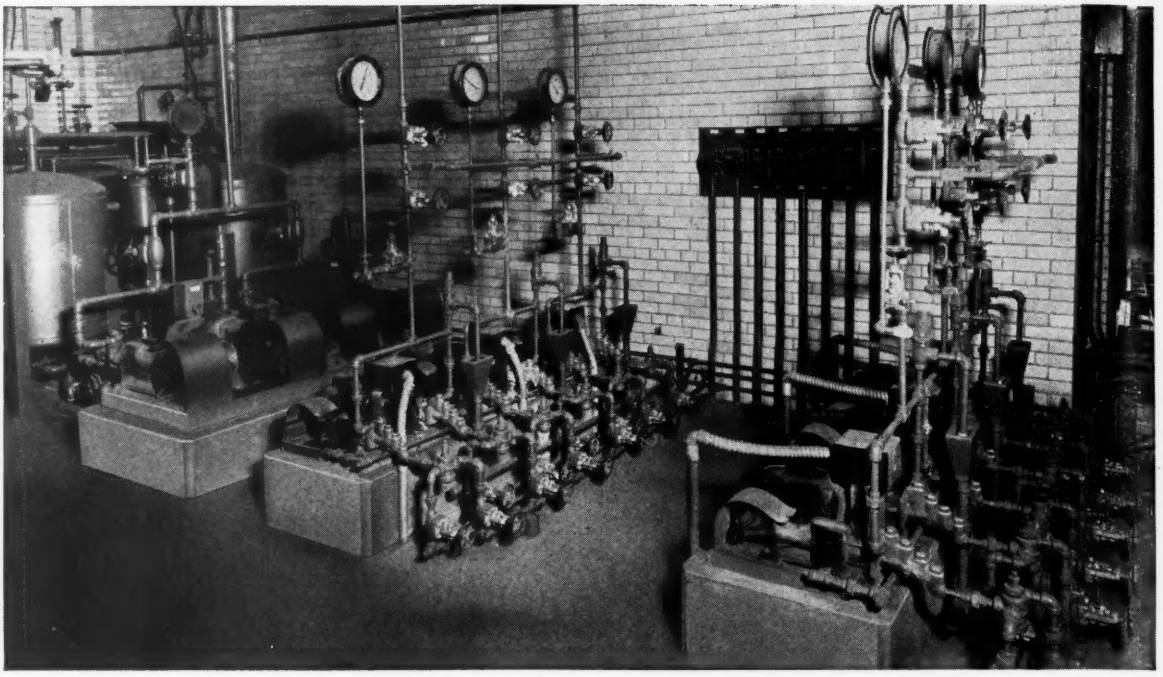
Complete information on Tycol Aturbrio Turbine Oils is available from your nearest Tide Water Associated Office. Write, wire, or phone, today.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia
Chicago • Detroit • Tulsa
Cleveland • San Francisco

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N.Y.

LUBRICATION—"ENGINEERED TO FIT THE JOB"



MILTON ROY BOILER WATER TREATING SYSTEMS AT SOUTHWARK STATION

At Philadelphia Electric Company's new Southwark Station, in Philadelphia, Milton Roy Chemical Feed Systems were installed . . . to feed phosphate direct to boiler drums and to feed sodium sulfite into the boiler water lines . . . as illustrated above.

The phosphate system consists of 2 Milton Roy Duplex Pumps each to handle 46 gph. at 1100 psi.

The sulfite system consists of 3 Milton Roy Duplex Pumps, each specified to pump 6 gph. at 80 psi. These pumps are driven through the G. E. Thymotrol system, an electronic variable speed drive, manually controlled to permit varying sulfite injection rate as water flow varies.

This installation is a typical Milton Roy System for boiler water treatment. Complete "Package" Systems can be furnished including all necessary pumps, solution tanks, covers, gage glasses, low-level cutouts and alarms, and motor starters.

Simplex or Duplex Pumps are supplied as required for these systems. Automatic electronic controls can be supplied to operate pumps at speed proportional to feed water flow as measured by flow meters. Systems are available to handle all treating chemicals and in capacities to meet all requirements.

Milton Roy Boiler Water Feed Systems will help you prevent scale, control alkalinity, remove dissolved oxygen, protect against embrittlement, corrosion and pitting caused by feed water impurities. Complete details in Bulletin No. 451. Ask also for Technical Paper No. 51 "What the Power Engineer Needs to Know About Chemical Feed Systems."

MILTON Roy COMPANY

WITH THE EXCLUSIVE STEP-VALVE DESIGN

1320 E. MERMAID LANE, CHESTNUT HILL, PHILA. 18, PA.

RIC-WIL *Prefabrication*

CUTS TIME AND COST of Piping Installations

Factory Insulation and Assembly Eliminates Costly Work at Job Site

● Specifying Ric-wiL Prefabricated Insulated Piping for underground, surface or overhead steam lines assures a permanent, efficient, trouble free system requiring only a minimum of field installation time and cost.

Combining flexibility and structural strength in design that makes them shockproof and durable, Ric-wiL Units are delivered to project sites in standard 21 foot lengths, in single or multiple pipe combinations, ready for immediate, single handling installation. Completely prefabricated, insulated and presealed at the factory, they are custom built to meet the individual specifications of any type of project requiring distribution piping between buildings.

With pipes and insulation supported in helically corrugated 16 gauge galvanized iron conduit, units are full seam welded, pressure tight, and protected by heavy coatings of asphalt and a tension wrapping of asphalt saturated felt. Conduit ends are pre-sealed to protect insulation at all times regardless of water conditions encountered.

Pipes can be turned easily in the conduit so that all field welding can be done from top position. Smooth iron collars, welded to conduit ends to match couplers, facilitate field coupling of units.

Because of their inherent strength and semi-rigid construction Ric-wiL Units for underground installations require only narrow trench with 18" ground cover under normal conditions, minimizing excavation and back fill.

Overall costs can be accurately predetermined and one order will cover every piping requirement. In addition to straight run units Ric-wiL also supplies a full line of expansion devices, anchors, fittings, drip legs, valve connectors and all other accessories needed for fast economical field installation of a complete system.

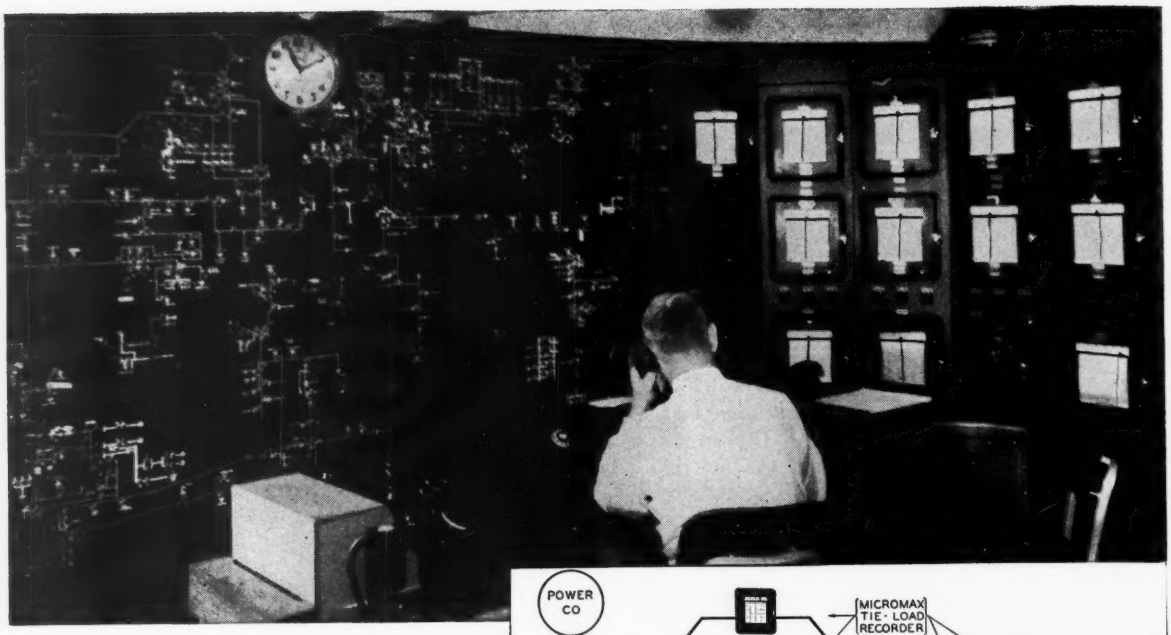
Send for Form 4626, Specification Data on Ric-wiL Prefabricated Insulated Pipe Units. Write: The Ric-wiL Co., Cleveland, Ohio, Department 784.

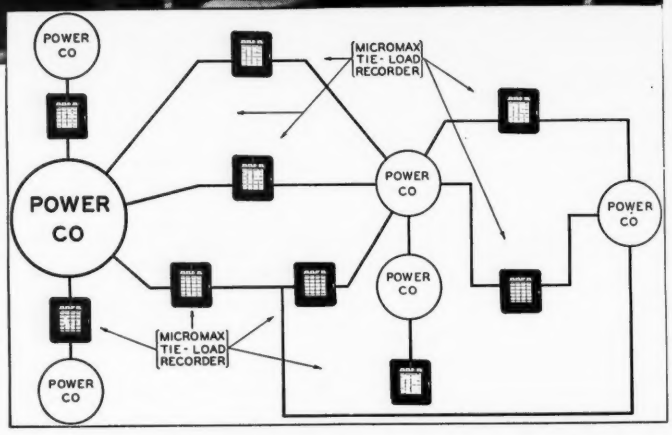
RIC-WIL

INSULATED PIPE CONDUIT SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

CABLE ADDRESS: RICWIL, BENTLEY'S CODE





Above: System operating room showing portion of a system map and 12 Micromax Load Recorders. At Right: Block diagram showing interconnections and 9 Micromax instruments which show tie-line load. The instruments shown in the photograph but omitted in the diagram are for tie-line bias, net interchange, and net system load.

Economic Distribution Of System Load

IS SPEEDED BY L&N TELEMETERING AND CONTROL

Tie lines radiate in various directions to the north, south and east from one of the country's big power systems, joining them to their power-company "neighbors." This pool of generating capacity carries a heavy interstate electric load, and the Company has found that L&N load telemetering and load-frequency control equipment is a "very definite help" in meeting the complex needs of system operation. The instruments help in two ways:

1. Operators can see continuously the load at any metered point. Because they can read either instantaneous load or load trends for some hours past, they can make on-the-spot decisions with speed and accuracy, and their instructions are carried out automatically.

2. Executives can examine, at their convenience, the load records for any period of time, and can base broad operating and policy decisions on a fuller knowledge of the size, shape and peculiarities of system conditions.

Over ninety percent of all interconnected capacity in the entire country uses L&N load-frequency equipment. Whether your facilities are interconnected or isolated; whether they need telemetering or just flat frequency control, there's an L&N equipment to suit your local conditions and handle all engineering and operating situations. We will send facts on request — you'll possibly need them in the future, if not now. Leeds & Northrup Co., 4973 Stenton Ave., Philadelphia 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl. Ad N-50-461(1)

● Edge Moor Radiant Heat Boiler equipped with Edge Moor vertical tube integral economizer. Fired with continuous discharge spreader stoker. 150,000 lbs. steam per hour, 500 lbs. pressure, 750° F. total steam temperature.

BOILERS *by* edge moor

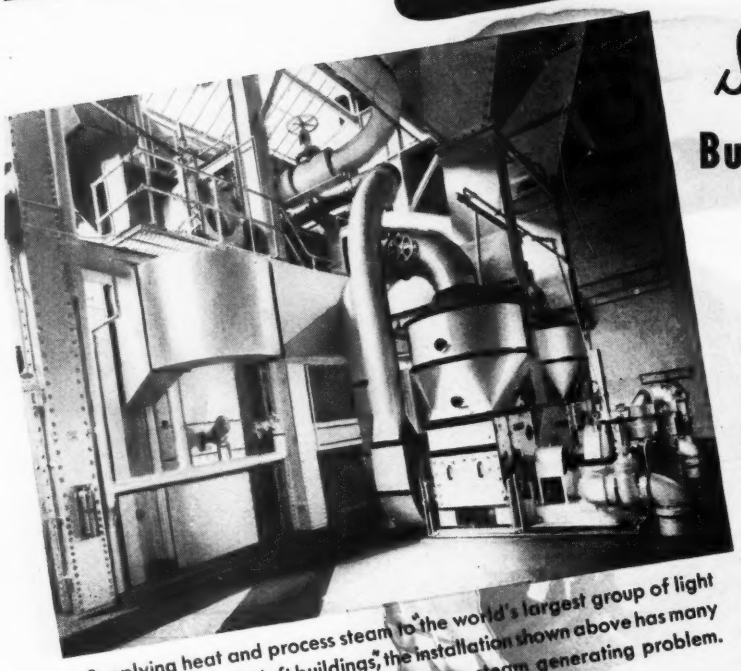
THE dependability, efficiency and flexibility of this unit has been made possible by 80 years of Edge Moor designing and engineering skill. Its design provides for a large water storage, generous steam liberation surface and quiet offtake drum. Maximum boiler tube surface is exposed to radiant heat and furnace cooling is arranged for a minimum of maintenance. This quick-steaming unit delivers continuous high ratings over many years and is adaptable to all fuels.

This and other types of Edge Moor boilers are available in a wide range of capacities, pressures and accessory equipment. Write for literature today. EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Delaware. Branch Offices and Agents: Atlanta, Boston, Chicago, Detroit, Hoboken, St. Paul, San Antonio and San Francisco.

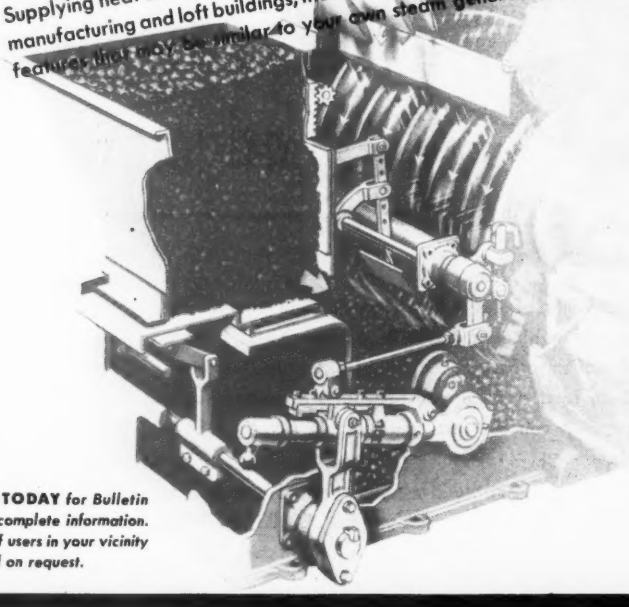
edge moor steam generating equipment

EM

Prepare NOW for Fuel EMERGENCIES



Supplying heat and process steam to the world's largest group of light manufacturing and loft buildings, the installation shown above has many features that may be similar to your own steam generating problem.



WRITE TODAY *for Bulletin 341 for complete information. Names of users in your vicinity furnished on request.*

STRONG SCOTT UNIT PULVERIZER

Burns ANY Bituminous Coal...Convertible to Gas or Oil

HERE'S a sure way to avoid coal-supply nightmares—install a STRONG-SCOTT Unit Pulverizer and you can burn any grade of bituminous coal available. Then if you *can't* get coal, switch to oil . . . or gas!

With efficient and flexible STRONG-SCOTT equipment and adjustable fuel-air controls, you can utilize *any* bituminous coal or by-product pitch—or convert quickly to oil or gas. With such fuel flexibility, power failures or fuel shortage nightmares never haunt STRONG-SCOTT customers. Many of them burn pulverized coal for heavy loads in winter, then switch to available oil or gas for light summer loads.

STRONG-SCOTT Unit Pulverizers increase the efficiency of your steam plant because they **(1) handle wet or frozen coal better, (2) assure constant firing—with uniform CO_2—regardless of load demands, (3) are simple to operate, (4) cost little for maintenance and (5) are simple in design, and rugged in construction.**

Dependable performance brings repeat orders, and over 40% of our units now in service were re-ordered by satisfied customers. Every STRONG-SCOTT installation is backed by 51 years of manufacturing experience—24 in the combustion engineering field.

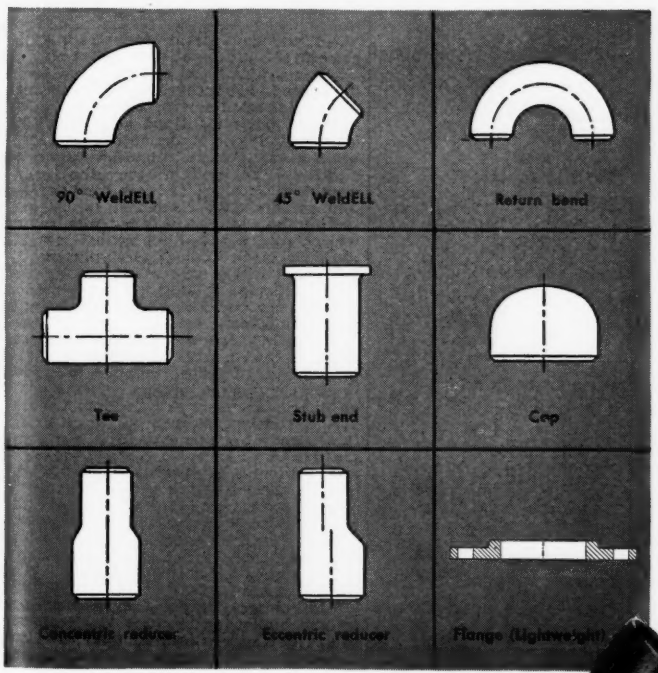
The STRONG-SCOTT Mfg. Co.
455 TAFT STREET N. E. • MINNEAPOLIS 13, MINN., U. S. A.

STRONG SCOTT UNIT PULVERIZER

Name the problem—

- *High temperature*
- *Low temperature*
- *Product purity*
- *Corrosion resistance*

Here's the answer!



Taylor Forge Welding Fittings and Flanges are available in:

Stainless 304, 316, 347, Monel, Inconel, Nickel, Copper . . . also other usual industrial metals.

Fitting sizes: ¾" through 12" and larger. Wall thicknesses: schedules 40-S, 80-S, 10-S and others. Flange sizes: ¾" through 30" and larger. Coupon brings dimensional data.

TAYLOR FORGE
& PIPE WORKS

General Offices: Chicago 90, Ill. (P.O. Box 485)
EASTERN PLANT: CARNEGIE, PA.

DISTRICT OFFICES

New York: 50 Church St. Philadelphia: Broad St. Station Bldg.
Chicago District Sales: 208 S. LaSalle St.
Houston: City National Bank Bldg.
Los Angeles: Subway Terminal Bldg.

☐ Send Taylor Forge Bulletin 476 covering stainless steel welding fittings and flanges.

☐ Add my name to your general mailing list.

Name_____
Position_____
Company_____
Department_____
Street Address_____
City_____ Zone____ State_____
SSS-6148
Mail to Taylor Forge & Pipe Works
P. O. Box 485, Chicago 90, Ill.

68-1-1

The company your boiler keeps . . .

APEXIORIZED

New boilers APEXIORized during the past year alone are serving these industries:

CHEMICALS	MACHINERY
FOODS	PUBLISHING
PETROLEUM	UTILITIES
BREWERIES	GOVERNMENT
TEXTILES	INSTITUTIONS
PAPER	MINING

Pick any industry where steam is generated for power or process and you've named a representative group of APEXIOR users — engineers who have proved the worth, in boilers large and small, of internal protective surfacing.

They know that even the strongest steel is powerless to resist moisture penetration — that water at its finest retains the capacity to impair — can never improve — bare steel. And so they separate the two, sealing boiler metal beneath a tissue-thin barrier of APEXIOR NUMBER 1.

Meeting steam and water is a surface that neither can dissolve — smooth, to deny a foothold to deposits — inert, so that it forms only a readily broken mechanical bond with any that adhere. The result, for the legion of APEXIOR users — —

- *maximum boiler availability — security against corrosion*
- *improved circulation, through friction-free tubes*
- *constant high heat-transfer efficiency*
- *easier, less frequent cleaning — lower maintenance cost*
- *speedier, positive inspection*
- *less outage time — longer on-the-line service*

Write us for more facts about:

DAMPNEY maintenance for metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

Instrument and Control Manual for Operating Engineers, by Eugene W. F. Feller, first edition; published by McGraw-Hill Book Co., Inc., New York, N. Y., 1947, 413 pages; price $6.00.

This is a book for the operator on the job for quick reference when needed. It explains the basic principles of control and operation of liquid level, pressure, temperature, speed, and humidity indicators and controllers. Feller then goes on to explain how the units of a control system are connected together to present, in effect, one unit of operation, and then tells how each unit affects the operation of the others.

The operating elements and fundamental principles of each type of control are explained and illustrated so that the operator may follow them quickly while on the job. Many of the principles of pressure and heat and liquid flow are presented for a quick review of physics. Photographs and cutaway drawings are shown so that practically all the working parts of the control devices are shown clearly. In the appendix a list of standard and non-standard automatic-control terms are given so that a uniform set of terms may be set up to aid in better understanding when speaking or writing of automatic-control and its operation. The author of this book has been, himself, an operating engineer and as such knows what the man on the operating floor wants to know. This book will apply to any place that has any type of automatic control at all, be it simple or complex. This applies to industrial as well as power plant controls.

Heating and Air Conditioning, by John R. Allen, James Herbert Walker, and John William James; 6th edition, 2d impression, 1946; 667 pages, size 6½ by 9 inches, cloth binding; McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York City; price $5.50.

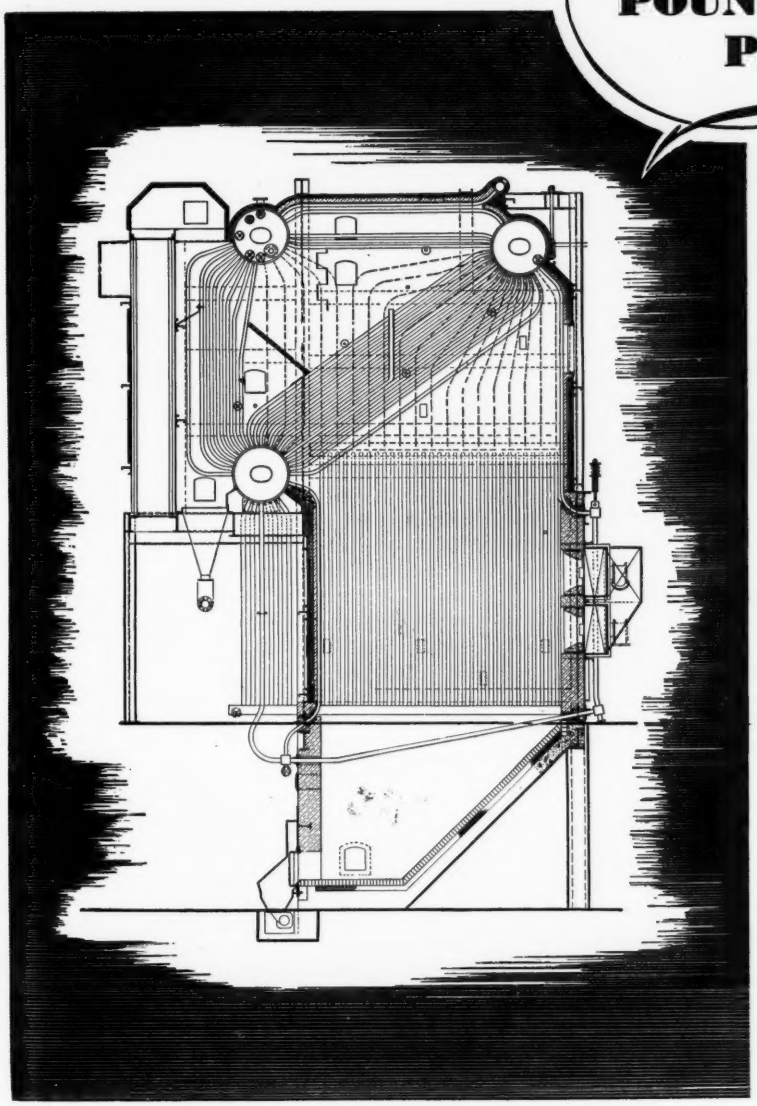
Although this is not strictly a new book, it is noted here because we have not previously informed our readers of the publication of this revised and up-to-date 1946 edition. It is one of the outstanding textbooks in this field and should be known to all those who need to study the fundamentals of heating and air conditioning. The authors have attempted to make it sufficiently thorough so that the reader will acquire a sound theoretical groundwork and some knowledge of practice.

Changes in the science of heating and air conditioning since the previous edition in 1939 have not been revolutionary but a number of details are brought up-to-date.

An entirely new section on panel heating is included, also a discussion of the principle of the heat pump or reversed cycle refrigeration system. The chapter on fuels and boilers now includes flue gas efficiency charts for gas, coal, or oil firing. Odor removal equipment and air sterilization are also discussed. Numerous changes will be found in the hot water heating chapter, especially the data on small forced circulation systems. Chapter XX discusses in detail the design of an actual air conditioning system and has been completely rewritten, in this edition, to cover a smaller and simpler design than in the former edition.

The contents of the book are divided into the following chapters: 1—Heat and the Properties of Steam and Air; 2—Heat Losses from Buildings; 3—Methods of Heating; 4—Gravity Warm-Air Furnace Heating; 5—Radiators, Convectors, and Unit Heaters; 6—Fuels and Boilers; 7—Steam Heating Systems; 8—Pipe, Fittings, Valves, and Accessories; 9—Steam Piping; 10—Hot-Water Heating Systems; 11—Automatic Control; 12—Central and District Heating—Electric Heating; 13—Air and Its Properties; 14—Principles of Air Conditioning; 15—Ventilating and Air Conditioning Systems; 16—Fans, Filters, Washers, and Coils; 17—The Transmission and Distribution of Air; 18—Cooling and Dehumidifying Apparatus; 19—The Cooling and Dehumidifying Load; 20—The Design of an Air-Conditioning System; 21—Residence Air Conditioning; 22—Unit Air Conditioners; 23—Industrial Air Conditioning.

90,000
POUNDS OF STEAM PER HOUR



Purchaser—
An Ohio Chemical Plant

Number of Boilers.....2

Pounds of Steam/Hr. .90,000

Design Pressure.....400 PSI

Operating Pressure . 385 PSI

Air Preheater—
Erie City Tubular

Water Walls—
Erie City Bare Tube

Water Screen—
Erie City Bare Tube

Method of Firing—
Pulverized Coal

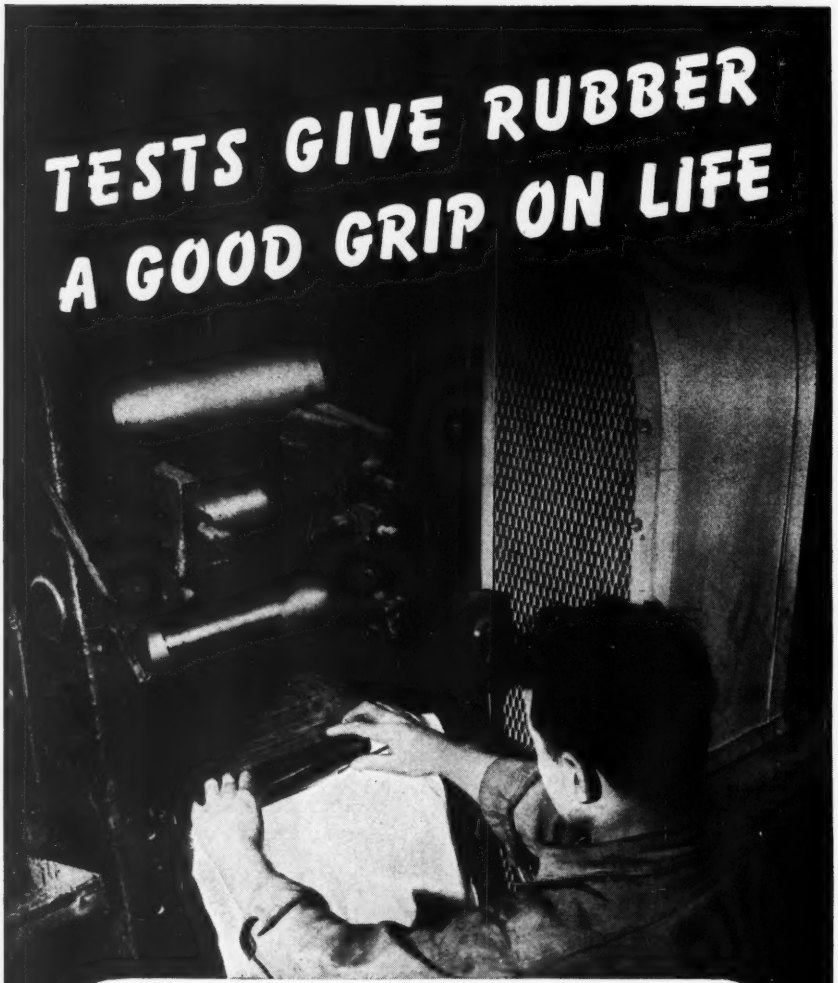
STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY
SINCE 1840

ERIE CITY IRON WORKS • ERIE, PA.

TESTS GIVE RUBBER A GOOD GRIP ON LIFE



The tight adhesion of rubber-to-fabric is an important factor in the long-lasting quality of belting, hose, packings. That's why Quaker technicians are constantly making adhesion tests after samples of rubber and fabric are "welded" by miniature calenders shown above, to assure a tight union.

This is only one of eighteen rigid tests that raw materials and finished products *must* pass before receiving the Quaker stamp of approval. Yes—pre-testing provides quality and long service . . . assures worthwhile dividends for you through higher plant efficiency, lower operating costs.

Call your nearest Quaker distributor for speedy service. He and the Quaker sales engineer are teamed to provide accurate recommendations on Quaker pre-tested belting, hose, packings.

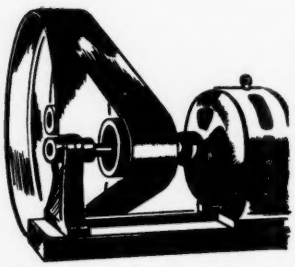
QUAKER RUBBER CORPORATION
PHILADELPHIA 24, PA. • New York 7 • Cleveland 15 • Chicago 16 • Houston 1
Western Territory
QUAKER PACIFIC RUBBER CO. • San Francisco 5 • Los Angeles 21 • Seattle 4

QUAKER RUBBER PRODUCTS

custom made for every industrial use

PRE-TESTING PAYS OFF WITH PEAK SERVICE

Check these pre-tested and proved Quaker products that help reduce operating costs for industries everywhere.

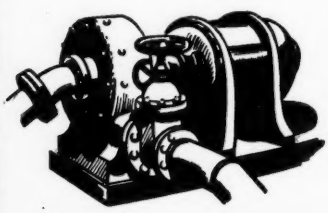


MORE POWER FOR PRODUCTION

In the complete line of Quaker transmission belts and belting pre-testing plays a vital part in providing long service, tight grip, slip-less power. Both V and flat types . . . transmission and conveyor, for all purposes.

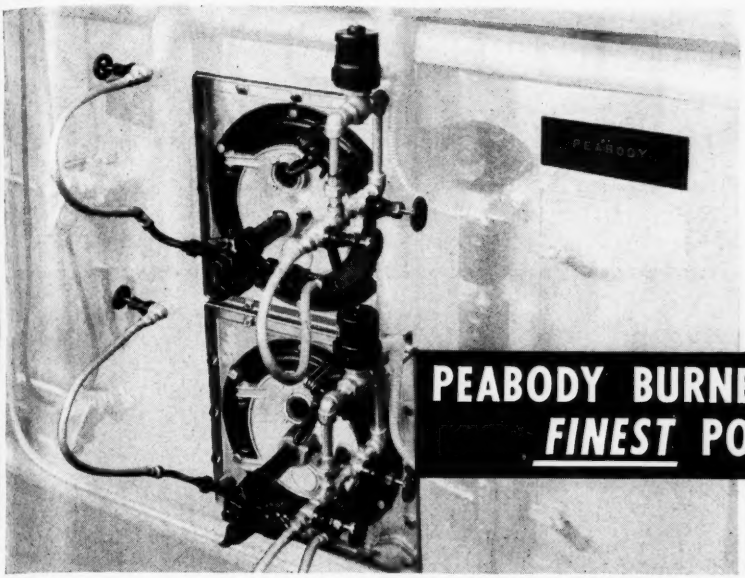
STANDS PRESSURE, RESISTS WEAR

Quaker hose, in moulded and wrapped construction, is ruggedly built of pre-tested materials for trouble-free transmission of air, steam, water, acids, volatiles. Tight adhesion of rubber and fabric resists pressure, twisting, severe wear.



STOPS LEAKS . . . CUTS COSTS

Quaker pre-tested packings for all purposes stop hot leaks cold . . . provide tight-sealing, long lasting service for valves, piston rods, flanges. Ideal for packing against steam, water, acids, volatiles. Call Quaker for solution to your packing problems.



Peabody ML-13½ Constant-Differential, Wide-Range Oil-Burning System—Installed at A. C. Gilbert Co., New Haven, Conn.

PEABODY BURNERS FIRE AMERICA'S *FINEST* POWER PLANTS

A. C. Gilbert* Plant High-Standard Installation!

*Manufacturers of the famous American Flyer toy trains and Erector sets.

WHEN the famous "American Flyer" plant converted from coal to oil-fired burners, they insisted upon getting not only fuel economy, but reduced maintenance costs and smooth, adequate response to *all* their steam demands.

Today, after installing two Peabody ML Oil Burners equipped with Peabody *Constant-Differential Wide-Range Oil-Burning System,* Gilbert engineers report complete satisfaction because they now have —

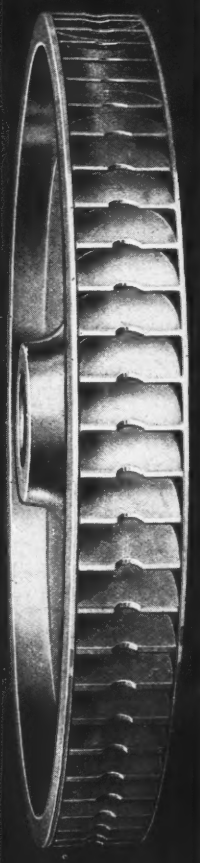
1. Instant response to slightest impulse from combustion control system (*resulting in substantial fuel economies*).
2. Minimized operator attention and reduced operating costs.
3. Simultaneous response of *both* burners to one fuel valve assures identical firing rates from both burners.
4. Uniform atomization over *entire wide range.*
5. Combustion air supply controlled by single damper. Smokeless operation. No changing register air-door setting when load changes.
6. Atomizers quickly interchangeable for cleaning and inspection.
7. Clean, efficient, quiet and trouble-free operation.
8. Electric-Eye Flame Protection.

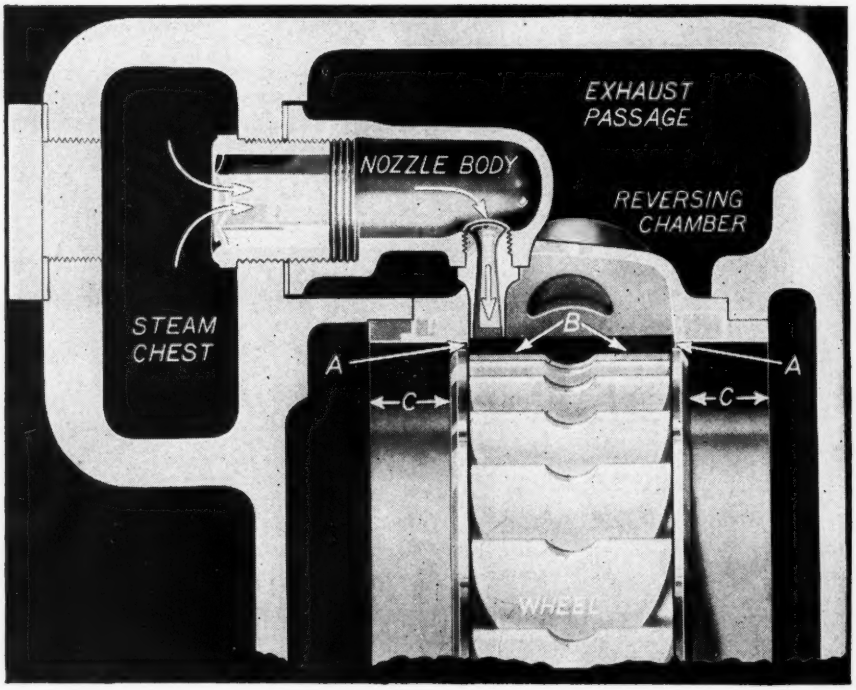
If your plant requires modern, efficient and adaptable combustion equipment, let Peabody Engineers work out a plan to fit your plant. There's no obligation and there's a Peabody office nearby. Call, or write direct.

PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Offices in Principal Cities

B-1

TERRY





AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

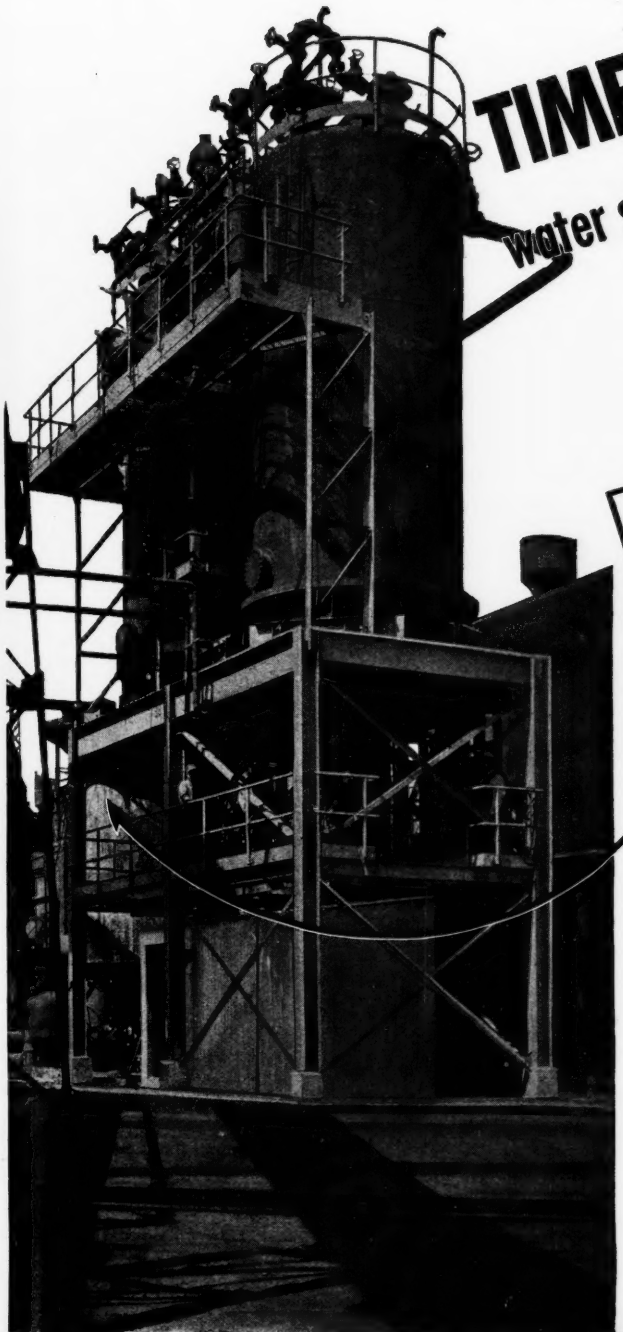
Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

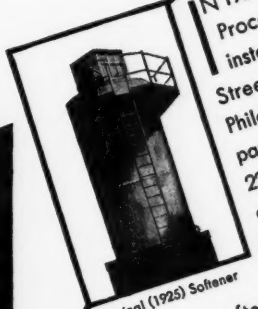
Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

TIME (and improvement in water softening) MARCHES ON!



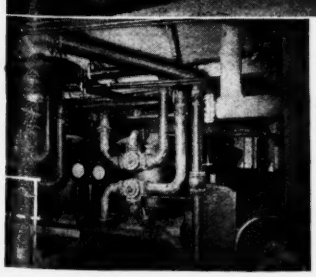


Original (1925) Softener

IN 1925, a Cochrane Hot Process Softener was installed in the Tilghman Street Gas Plant of the Philadelphia Electric Company at Chester, Pa. Now, 22 years later, this faithful old piece of equipment is being replaced by a new Cochrane Double Unit Hot Process Softener of 20,000 GPH capacity (10,000 GPH per unit). The double unit permits great flexibility of operation as one or both units may be used as desired. The needs of the plant have outgrown the capacity of the first unit which is largely the reason for the change, but the improvements in the process and the apparatus since 1925 are interesting in comparison with the old veteran. Welded construction replaces riveted, chemical proportioning and feeding are improved, automatic controls are featured and softening is accomplished with a speed and accuracy of result undreamed of in 1925.

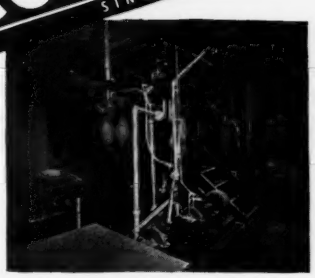
COCHRANE CORPORATION 85 YEARS OF SERVICE 1863 - 1948

COCHRANE SINCE 1863



(Left) Two vertical pressure filters replacing existing conical filters shown in background

(Left) phosphate tank with motor driven agitator for mixing supplemental phosphate feed



(Left) Lime soda proportioners and mixing tanks

COCHRANE CORPORATION • 3123 N. 17th Street • PHILADELPHIA 32, PA.

Carload of Life Preservers

Our No. 49417
Customer's No. 39344
CONSUMERS POWER COMPANY
WEADOCK STATION
BAY CITY, MICHIGAN
FROM
AMERICAN BLOWER
AMERICAN BLOWER CORPORATION
DETROIT 32, MICHIGAN, U. S. A.
MANUFACTURERS
INDUSTRIAL FANS · HEATING · DRYING · AIR CONDITIONING · COMFORT COOLING · VENTILATING
MECHANICAL DRAFT · FLUID DRIVES · DUST COLLECTORS

Here's a different type of preserver—one which prolongs the life of induced draft fans and alleviates an air-pollution problem by collecting fly ash.

This American Blower Type ST Precipitator is on the way to another of America's famous producers of power. It will be used on a pulverized-fuel-fired boiler unit.

Story behind the story: this is the fourth such shipment to this customer since 1938! And two more are on order.

Yes, products can be judged by the company they keep—especially when those companies re-order again and again from the same source.

If you're interested in figures: The American Blower Type ST Fly Ash Precipitator unit, shown, is designed for a 550,000-pound steam generator and will handle 295,000 cfm of flue gases at 320° F. Write for Bulletin 1628.

AMERICAN BLOWER CORP., DETROIT 32, MICH.
CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.

AMERICAN BLOWER

Division of American Radiator & Standard Sanitary Corporation

. . . if so, assure oil withdrawal in coldest weather with a G-FIN TANK OIL HEATER

Note These Advantages of the G-R G-FIN Tank Oil Heater

GREATEST HEATING EFFECTIVENESS . . . provided by the G-FIN elements which have six to eight times the heating surface of bare tubes

MOST COMPACT UNIT . . . fewer tubes and shorter shell for a given duty

LEAST PRESSURE DROP . . . has maximum free area and straight-through flow of oil

NO STRATIFICATION OR VAPOR BINDING . . . oil outlet at top of shell prevents dead pocket

USES LESS STEAM . . . heats oil only locally at point of withdrawal

FEWER TUBE JOINTS . . . resulting from small number of required heating elements

ACCESSIBILITY . . . easily examined and cleaned throughout entire length and diameter of heating elements

LEAKPROOF JOINTS . . . the conical ends of the heating elements are seated in the tube sheet with accurately machined metal-to-metal joints held tight by lock-nuts

NO TEMPERATURE STRAINS . . . the U-bend elements are free to expand or contract

Many hundreds of installations of the G-R G-FIN Storage Tank Oil Heater have fully demonstrated the speedy action, thorough reliability, low steam consumption, and economical maintenance of these units.

Users report that even in sub-zero temperature, or where oil has partly solidified through long periods of storage, these highly effective heaters assure a steady flow of oil soon after steam has been turned on.

Wherever fuel oil, lubricating oil, crude oil, road oil, tar, asphalt, glycerine, cotton seed oil, molasses or other viscous liquids are stored . . . at process plants or power plants, tank farms or distributing centers, loading wharves or platforms . . . the G-R G-FIN Tank Oil Heater is a necessary insurance against difficulties or delays in oil withdrawal. Available for installation outside of, or partly within the tank.

Write for Bulletin 1641 describing these units in detail.

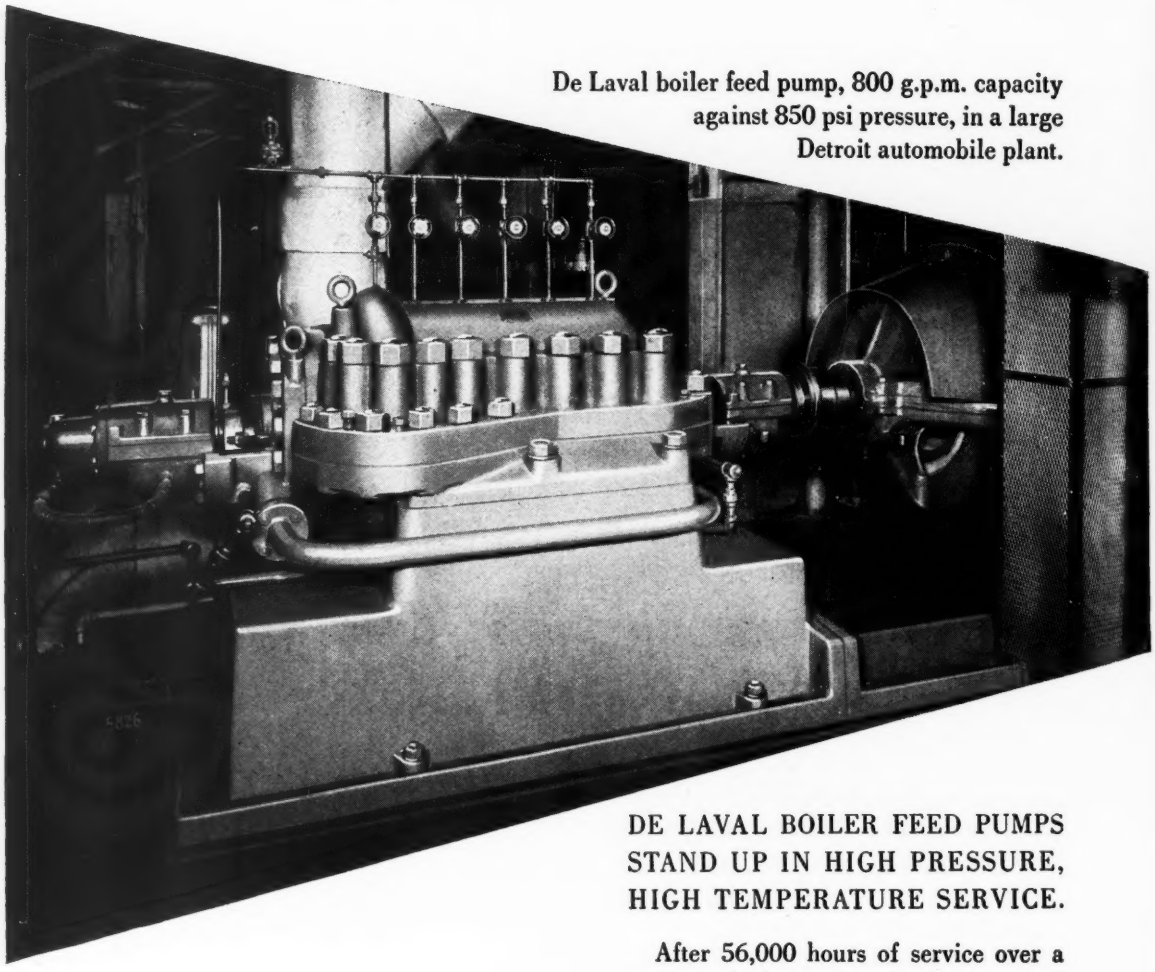
THE GRISCOM-RUSSELL CO.

285 Madison Avenue **New York 17, N. Y.**

GR-133

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



De Laval boiler feed pump, 800 g.p.m. capacity against 850 psi pressure, in a large Detroit automobile plant.

"IN EXCELLENT CONDITION after 56,000 hours"

reports inspector

DE LAVAL BOILER FEED PUMPS STAND UP IN HIGH PRESSURE, HIGH TEMPERATURE SERVICE.

After 56,000 hours of service over a period of nine years, the power plant superintendent of a large Detroit automobile manufacturer asked for an inspection of this pump. The inspection was made and the following report received.

"We completely disassembled the pump and found wheels, diaphragms, shaft, bearings and all other parts in excellent condition. There was no washing of the pump case or any kind of corrosion. The shaft sleeve was highly polished. Balance parts including labyrinth leak off and the leak off bushing over the discharge end of the shaft sleeve hubs had but .005" wear."

In every detail De Laval pumps are designed for long trouble-free service.

Atlanta • Philadelphia • Charlotte • Pittsburgh
Cleveland • Rochester • Detroit • San Francisco
Chicago • New York • Denver • Kansas City
Helena • Boston • Houston • Washington, D. C.
St. Paul • Los Angeles • New Orleans • Seattle
Salt Lake City • Tulsa • Edmonton • Winnipeg
Toronto • Vancouver

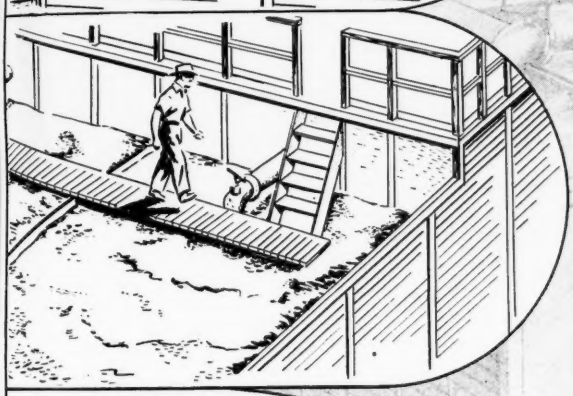
DE LAVAL

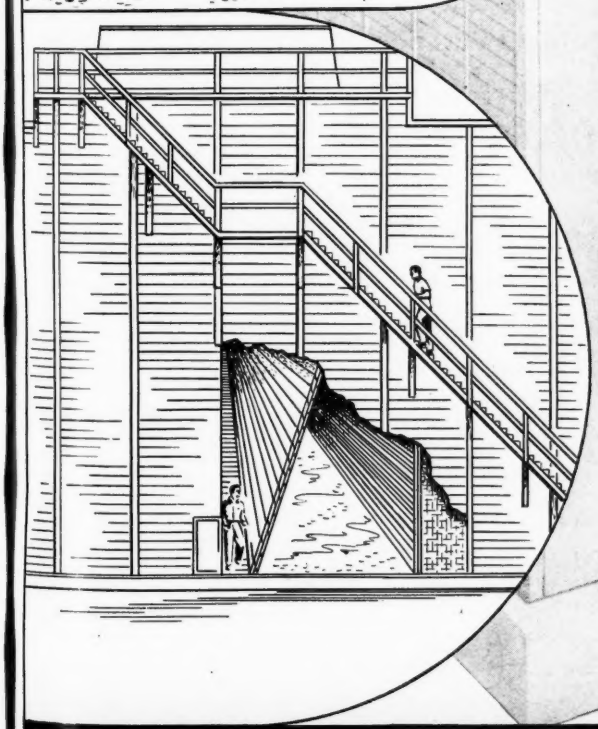
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

BF-4

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

SAFETY A Fundamental Factor In Every *Double-Flow* COOLING TOWER





There is a new man in the cooling tower picture—the Safety Engineer. And Marley is justifiably proud that Safety Engineers for the nation's great industries heartily approve the Double-Flow. Their study has proved that only the Double-Flow is inherently safe.

Ascend the strongly hand-railed stairway of the Double-Flow to the fan deck. Inspect the sturdy, high-walled fan cylinders . . . high enough for safety, low enough for ease of inspection. There is plenty of room to walk easily along the fan deck, inside the complete hand-rail. Plenty of room to walk without contact with power lines . . . no danger from gusty winds.

Go down the short stairway to the open distribution basin. Again complete walkways facilitate inspection of this unique Double-Flow feature. Water flow is checked at a glance. Cleaning is a safe, simple operation only in Double-Flows.

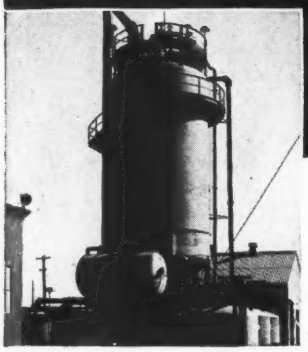
Now step inside the tower through the inspection doors. On another walk you can travel the length of the tower, observe water break-up, condition of eliminators, vapor travel. Double-Flow full-height louvre walls give full daylight inside the cooling chambers.

Tower operators know that Double-Flows are safe towers . . . safe in any weather. They do not hesitate to give the Double-Flow full attention at all times.

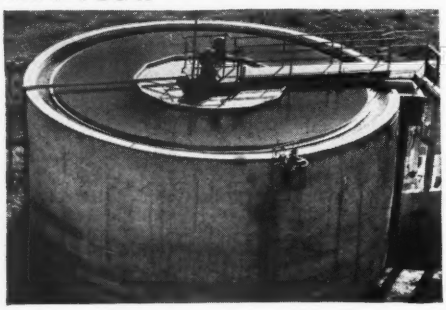
MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

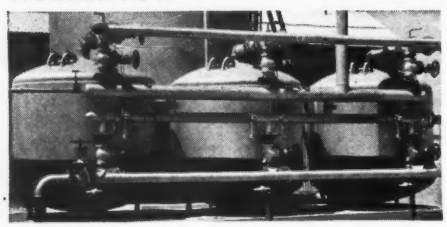
Which is YOUR kind of water?



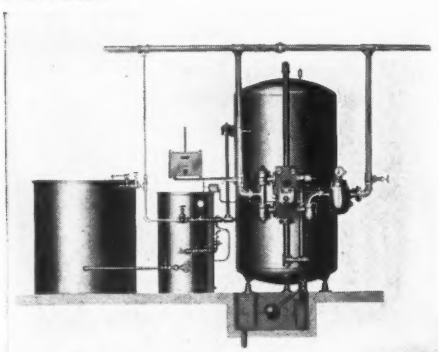
HOT-FLOW*



ACCELATOR*



FILTERS



ION EXCHANGER

Maybe the four kinds of water listed do not exactly describe your water supply, but—

No matter what kind of water you must use, it is more than likely that it is not entirely satisfactory for boiler feed, process use, cooling system makeup, etc.

Maybe you have a water treating plant, but is it economical and efficient, as measured by current standards?

Various types of INFILCO equipment pictured here—separately or in suitable combinations—will "tailor" your water to your needs.

When would you like for one of our engineers to call? INFILCO Inc., 325 West 25th Place, Chicago 16, Illinois.

*Trade-Mark Reg. U. S. Pat. Off.

CLEAR HARD HIGH-SILICA

CLEAR HARD LOW-SILICA

MUDDY HARD HIGH-SILICA

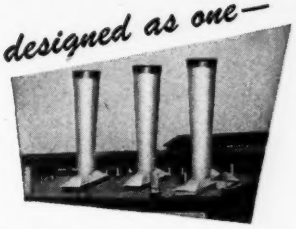
COLORED SOFT LOW-SILICA

IF YOU WANT TO KNOW — ASK INFILCO

a 3 in 1 unit

FAN-BREECHING-STACK

designed as one—

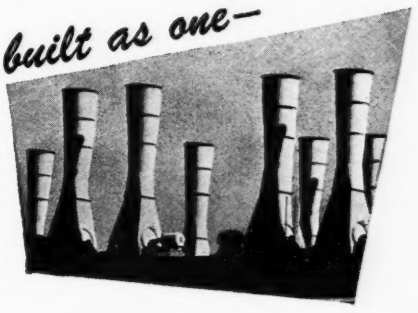


Mounted directly at the boiler outlet, the Thermix Fan-Stack eliminates necessity for expensive stack supporting structure. This installation method also obviates the necessity for the usual type of breeching to stack, to which many costly draft losses can be traced.

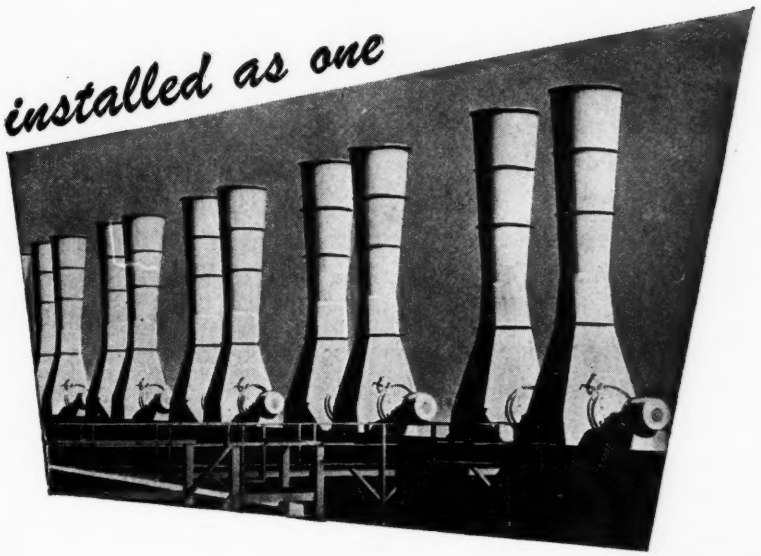
The Thermix Stack is of the divergent type. The dynamic energy in the gas is converted to the necessary static energy, thus assuring maximum operating efficiency.

Check your boiler draft situation—now! It will cost you nothing to let Thermix field engineers make their recommendations. Countless cases throughout industry prove that it may pave the way for an improvement in efficiency, or even an increase in steam output with your existing boiler that will come as a pleasant—and profitable—surprise.

built as one—



installed as one



THE THERMIX CORPORATION

Project & Sales Engineers

FIRST NATIONAL BANK BLDG., GREENWICH, CONN.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

PUTS THE PROFIT IN THIS EQUATION

The log mean terminal temperature difference goes down and stays that way when chlorination goes to work and stops slime formation on the water-side surfaces of your condensers and heat exchange equipment. This means lower fuel costs, less out-of-service time, the elimination of plug cleaning, more profit.

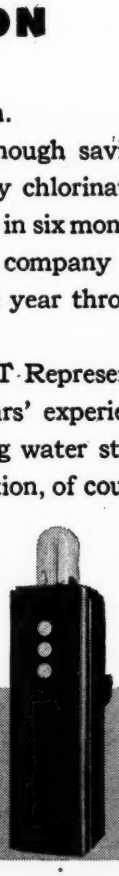
Since even the slightest slime film means a high LMTTD, it is important that the remedy get at the basic cause of the trouble—slime forming organisms. That's just what chlorination does and here are some typical examples of the profitable results:

A southern power station realized a net annual saving in steam costs alone of $16,000 from a W&T installation.

A refinery obtained enough savings through condenser de-sliming by chlorination to pay the cost of the installation in six months.

A midwestern power company obtained savings of $11,000 in one year through cooling water chlorination.

Call your nearest W&T Representative, backed by over thirty years' experience in water treatment, for a cooling water study of your plant—there's no obligation, of course. and you may find, as so many other plants have, that the LMTTD isn't as low as it could be with chlorination.



WALLACE & TIERNAN
PRODUCTS, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
Belleville 9, New Jersey • Represented in Principal Cities

CD-28

How faithful

are your

"faithful" old pumps

There comes a time in the life of *everything mechanical* when it is no longer profitable to keep it in operation. Time takes its toll in fatigue, wear and obsolescence.

Pumps are not exceptions

Old pumps may continue to run and give "satisfactory" service. However, tests usually show a steady decline in efficiency, a steady rise in power requirements and maintenance costs.

If your pumps are not giving the service you now expect, or your pumping requirements have increased, it is time to talk with a Warren representative. Write to us or to our nearby office.

WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts

For continued high efficiency, low power consumption, low maintenance costs · · · replace with

Warren Pumps

CENTRIFUGAL AND RECIPROCATING

Atlanta Boston Chicago Cleveland Denver Detroit Houston Manchester, Conn. Los Angeles Minneapolis New Orleans New York Philadelphia Pittsburgh Richmond San Francisco Seattle St. Louis

P-12

These Features Make

DART UNIONS OUTSTANDING

1. BRONZE-TO-BRONZE BALL JOINT

Bronze meets bronze in each Dart Union to form a *true ball joint* that is non-corroding.

2. DROP-TIGHT SEATS

These precision-ground bronze seats make a drop-tight connection which insures longer, more economical, *leak-proof service.* No heavy wrenching is necessary with Darts for they close and open easily.

3. RUGGED CONSTRUCTION

Body and nut made of high-test, air-refined malleable iron —practically indestructible.

Your supplier will gladly show you these outstanding money-saving features.

DART UNIONS

E. M. DART MANUFACTURING CO.
PROVIDENCE 5, RHODE ISLAND

REGENERATIVE REHEATING

(Continued from page 57)

of the diaphragm and on down through the lower blades to the bottom drain. The condensate would be discharged at the temperature corresponding to the heating steam pressure, to re-enter the feed cycle. No external piping or apparatus is needed, other than simple drain connections. Only two stages of reheat are shown, for purposes of illustration, but three or more would probably be justified on the basis of economics.

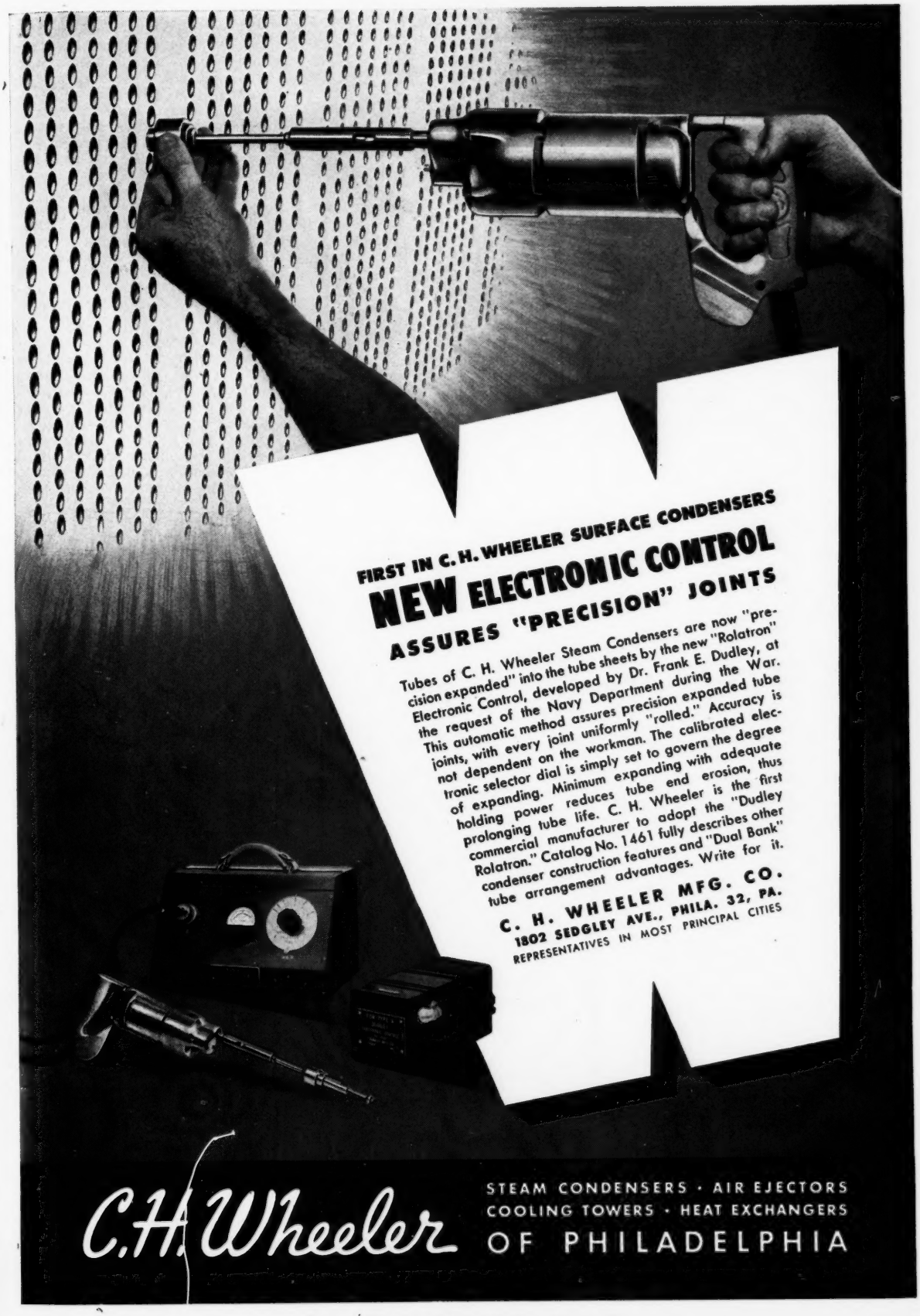
This method of regenerative reheating requires a heat transfer and surface relation in the hollow stationary blades sufficient to evaporate about 1.5 per cent moisture per reheat stage. This 1.5 per cent represents the moisture increase per stage resulting from the conversion of heat into work. Available information indicates that a coefficient of heat transfer of 1100 may be expected with mild steel hollow blades 0.15 in. thick, or about 1600 with copper. These values are for clean blades without promoter surface, in a region where sufficient water is present to wet the blades. After the moisture is evaporated, the coefficient when superheating would drop to about 70. On the basis of the heat transfer indicated for mild steel hollow blades, the moisture produced per stage may be evaporated with a mean temperature difference of 80F just below the dew point and 40F or less for the lower stages. With the use of hollow copper blades the conditions would be more favorable and a lower temperature difference would suffice.

While the evaporation of moisture takes place only where it is present in wettable amounts, there is reason to believe that turbine efficiency is impaired only when moisture droplets are of appreciable size and the supersaturation zone has been definitely crossed. In this event, moisture that impairs efficiency may be evaporated. The actual transfer rate may be determined experimentally by the installation of simple exploratory surface in appropriate locations in the low-pressure turbine.

Power Recovery from Reheating in Turbine

Table II indicates probable performance of reheating stages with surface relations found in existing turbines. It is based on a distribution of moisture losses as indicated in Table I with the use of mild-steel hollow reheating blades. The values in the table were calculated for a coefficient of 1000 with 5 deg loss in mean temperature difference (M T D) and enthalpy at saturation. Only five stages were considered in the example to illustrate the moisture reducing and power recovery possibilities of this method of reheating. Additional heating stages upstream would add substantially to the recovery indicated.

In Table I the losses are indicated


FIRST IN C. H. WHEELER SURFACE CONDENSERS
NEW ELECTRONIC CONTROL
ASSURES "PRECISION" JOINTS
Tubes of C. H. Wheeler Steam Condensers are now "precision expanded" into the tube sheets by the new "Rolatron" Electronic Control, developed by Dr. Frank E. Dudley, at the request of the Navy Department during the War. This automatic method assures precision expanded tube joints, with every joint uniformly "rolled." Accuracy is not dependent on the workman. The calibrated electronic selector dial is simply set to govern the degree of expanding. Minimum expanding with adequate holding power reduces tube end erosion, thus prolonging tube life. C. H. Wheeler is the first commercial manufacturer to adopt the "Dudley Rolatron." Catalog No. 1461 fully describes other condenser construction features and "Dual Bank" tube arrangement advantages. Write for it.
C. H. WHEELER MFG. CO.
1802 SEDGLEY AVE., PHILA. 32, PA.
REPRESENTATIVES IN MOST PRINCIPAL CITIES
C.H. Wheeler
STEAM CONDENSERS · AIR EJECTORS
COOLING TOWERS · HEAT EXCHANGERS
OF PHILADELPHIA

SEAL
THAT STEAM!

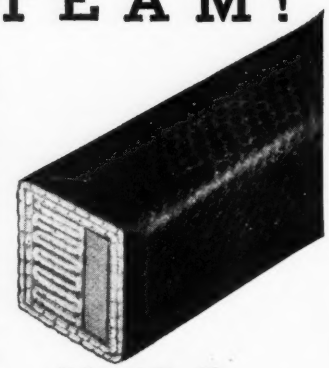
Advertisement

PACKINGS HOLD IMPORTANT PLACE IN MODERN PLANT

PHILADELPHIA, PA.—To keep pressure up and cost down, modern plants, "leak-proof" moving and stationary parts with Belmont Packings.

Since 1893, Belmont Packings have been solving these problems for industry, with highly specialized packing designs and constructions to meet every industrial requirement. Here, we illustrate just two Belmont steam service leaders. Our catalog displays all.

Belmont No. 30, for high pressure steam rods and expansion joints. Made of closely woven asbestos cloth treated with special rubber compound. Center block pleated on itself (accordian fashion) at approx. 90° angle with rod, affording high resiliency and flexibility. Provides extra take-up and "edgewear" if packing wears toward the rod.



Belmont No. 30
High Pressure Asbestos Packing for rods, expansion joints, air and gas.

BELMONT PACKINGS

Belmont No. 754, for reciprocating rods and plungers against high pressure steam, expansion joints, etc. Made of long fibre asbestos yarn with fine copper wire twisted with each strand. Lubricated throughout and graphited, this square braided packing retains its softness over a long period of use.

Belmont Packings are easy to obtain and convenient to see; distributors are located in every large industrial center, with sample kits displaying Belmont constructions and materials.

Identification is simple. Belmont Packings wherever practicable, are packed in attractive and secure boxes, bearing our orange-colored trade-mark on a blue background.

The Belmont Catalog is available. This invaluable reference book reduces packing facts down to simplest forms. Write on your company letterhead for free copy

Investigate how Belmont can serve you! Contact our local distributor, or write us direct.

Belmont No. 754
Square Braided Asbestos Wire Inserted Packing for reciprocating rods and plungers, expansion joints, etc.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.

THE BELMONT PACKING & RUBBER COMPANY
BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

separately for each stage. In Table II the recovery is cumulative; that is when moisture is evaporated in an upper stage, there is a gain in efficiency and power recovery in each following stage. This method of reheating is confined to the subsaturation region, since the heat transfer coefficient attainable under these conditions is sufficient for the blade surface that is available. In the superheat region above the dew point, the smaller blade surface and lower transfer rate is too limited for consideration without substantial design modifications. The total losses due to moisture are fairly well established but the precise distribution is somewhat uncertain due to the effect of supersaturation.

There is reason to believe the loss due to moisture in the last two stages is greater than is usually indicated. Water erosion of these blades indicates substantial dissipation of energy in impact or mechanical friction, as manifested in Fig. 1. Appreciable quantities of moisture are evaporated by this impact at a fuel cost of 3000 Btu per lb evaporated. That is: Heat rate × (enthalpy of evaporation ÷ 3413)=10,000 × (1020÷3413)=3000 Btu per lb, as contrasted with the usual fuel requirement of about 1200 Btu per lb evaporated. This is the practical equivalent of dehydration by electric heating from the generator leads.

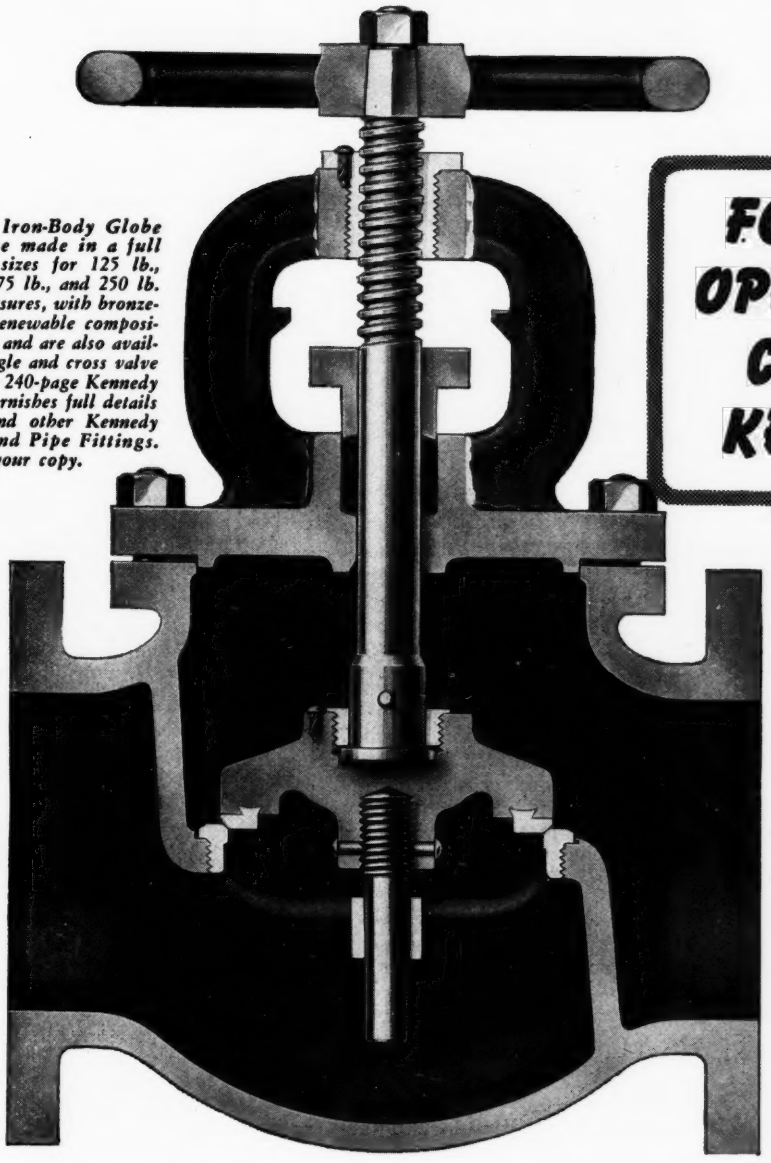
By evaporating this water with bleed steam in hollow blades, waste heat may be substituted for mechanical or hydraulic friction, thus recovering the energy normally dissipated. Waste heat is obtainable for the expenditure of 60 Btu of available energy necessary to provide the heat transfer head across the heated blade surfaces. For a sacrifice of 60 Btu per lb (adiabatic heat drop) 900 Btu otherwise rejected to the condenser may be substituted for its mechanical equivalent. The fuel cost of recovering this energy is (3413 ÷ 900) × (60 ÷ 0.85) = 270 Btu per increment kw hr.

Since the stages in which these losses occur are in the low-temperature low-pressure region, low-cost materials and simple methods of construction may be utilized. Thus, with comparatively simple modifications, efficiency may be increased, blade erosion eliminated and initial pressures raised without sacrificing operating simplicity.

Nowhere else in the steam turbine plant is there such an attractive opportunity for economic gain.

WHILE ELEVATOR cables should be examined thoroughly, particular attention should be made to those sections which pass oveh the sheaves more frequently. When breaks show in the wires, cables should be watched even more carefully and inspected more frequently.

KV-178



Kennedy Iron-Body Globe Valves are made in a full range of sizes for 125 lb., 150 lb., 175 lb., and 250 lb. steam pressures, with bronze-faced or renewable composition discs, and are also available in angle and cross valve types. The 240-page Kennedy Catalog furnishes full details on this and other Kennedy Valves and Pipe Fittings. Send for your copy.

FOR EASY OPERATION CHOOSE KENNEDY

The Kennedy Iron-Body Globe Valve is an apt example of how Kennedy design contributes to easy operation.

From handwheel to packing gland, this valve is built for effortless opening and closing. The deep stuffing box permits tightness without undue pressure on the packing. The stem and stem contact surfaces are accurately threaded... won't bind or grind. The large diameter handwheel provides a firm comfortable grip and ample leverage... no grunt-and-groan effort needed to open or shut this valve.

Maintenance, too, is easy because of the careful attention given to this problem at the design stage and because the quality of each part is more than adequate. Glands and packing are readily accessible for convenient repacking.

Yes, sir, for easy operation and simple maintenance, choose Kennedy every time.

Buy from Your Local Distributor

THE KENNEDY VALVE MFG. CO., ELMIRA, NEW YORK
Offices and Warehouses in Principal Cities

KENNEDY valves-pipe fittings-fire hydrants

EXTRA POWER IN A SMALL MOTOR

means faster more thorough tube cleaning

AT LESS COST

Size for size, the Wilson ECT Series Air Motor will develop up to 40% more power than ordinary motors. That's why it can deliver maximum power at the most efficient cutter head speeds, *with less air consumption.*

The exclusive six-blade, light-bladed construction of the ECT Air Motor, together with automatic valving of operating air, assure maximum power from every cubic foot of air. 12 powerful impulses per revolution produce smoother flow of power—higher torque at any speed.

All this adds up to tube cleaning economy and lower air consumption. Whether you're cleaning water tubes or fire tubes a Wilson ECT Series Cleaner will mean faster cleaning for less down time, thorough cleaning for production savings.

For detailed information, write to Dept. T TW-744

THOMAS C. WILSON, INC.
21-11 44th AVE., LONG ISLAND CITY 1, N. Y.
CABLE ADDRESS: "TUBECLEAN," NEW YORK

WILSON
TUBE CLEANERS

HOW TO CONSTRUCT OVERFIRE JETS

(Continued from page 65)

can be the blower pressure. The duct velocity should not exceed 200 fpm unless necessary.

Using the penetration necessary and the air tube dia the air weight per air tube in lb per hr will be found in Fig. 2. Multiply this by the number of tubes for the total blower capacity. Consulting the catalogs of the blower manufacturers the right size blower and motor will be found. For construction details see Fig. 4.

Design and Construction of Steam-Air Jets

If the blower jets are unavailable or not advisable the air may be injected at high velocity with steam pressure. The same method is followed for selecting steam-air jets as was used for the blower jets except the blower pressure and capacity. This will of course be different with the steam-air jet.

Using Fig. 5 take the weight of

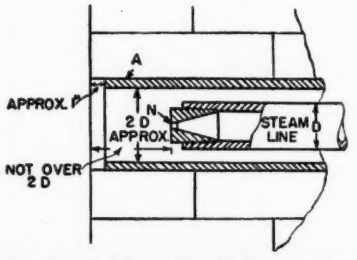


Fig. 10. Steam jet for turbulence alone no air entrained

(A) Air tube. Size not critical. Twice diameter of steam line should be ample to permit flow of sufficient air to cool nozzle. Nozzle can be made of pipe plug, counter bored or drilled, screwed into internal pipe thread or into coupling. Pipe cap can be used but scale accumulation may be encountered. Nozzle need not be accurately centered and should be no more than one air tube diameter back of wall outlet

air per tube per hr and air tube diameter with the steam pressure to be used the steam nozzle diameter will be found.

The steam pressure and the nozzle diameter used in Fig. 6 will give the rate of flow in lb per hr for one nozzle. Multiply this by the number of nozzles to determine the total steam flow.

The steam-air jet is a simple device, Fig. 8, that almost anyone can make with a few parts of the right size and a few tools. There are certain points that may vary with the different installations.

The air tube can be made of standard pipe. The desired funnel-shaped entrance can be made from plastic refractory or a standard pipe coupling reducing from at least two sizes larger than the air tube.

The steam nozzle can be made from an ordinary pipe plug, but will last much longer if made from heat

Reliance EYE-HYE

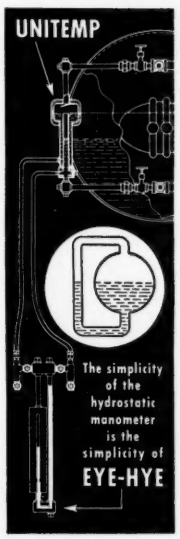
brings you accurate fool-proof remote water-level reading for any boiler or tank

Standard equipment in thousands of power plants

● This dependable step-saving remote reading gage brings boiler water level indication down to eye level—indicates clearly in green fluid, brightly illuminated—unmistakable. When you've installed your first EYE-HYE, you recognize its potential value on all liquid-containing vessels, as a guard against liquid level accidents—as a help in achieving operating efficiency. Besides the main boilers you can use EYE-HYE on heater tanks, flash tanks and various types of storage vessels—even on sizes with level variation up to 12 feet.

Hydrostatic operation means constant full-range accuracy; factory calibration eliminates adjustments on location: EYE-HYE can't be tampered with in service. Easy to install—practically no maintenance. Can be placed in any convenient location where operators can see and read it *frequently*. . . . It pays you to learn more about the EYE-HYE. Write for full particulars.

For the fellow who likes to know how things work, here's the story of EYE-HYE's a-b-c Simplicity



EYE-HYE operates on the principle of the U-tube manometer. EYE-HYE itself forms the bottom of the U; two tubes connecting it to the boiler drum complete the two legs.

Condensation of steam in the special reservoir—the Unitemp—maintains a level of water in one leg of the EYE-HYE hookup equal to the predetermined maximum *high* water level in your boiler. As water in the boiler rises or falls it exerts a varying pressure on the opposite leg. Unitemp also equalizes the *temperature,* and therefore the specific gravity, of water in both legs.

Counter-balancing these two pressures is a high specific gravity liquid in the bottom of the U-tube which will not mix with water, so water in the two legs pushes it back and forth according to the difference in hydrostatic head pressure. Thus the liquid (of a rich green color) is always in the same relative position between the two columns of water . . . and becomes the visual indication of the rise and fall of water level in the boiler.

BOILER SAFETY DEVICES since 1884

Reliance

THE RELIANCE GAUGE COLUMN CO. · 5902 CARNEGIE AVENUE · CLEVELAND 3, OHIO

For BOILER WATER LEVELS . . .

The Henszey Boiler Feed Regulator provides a low cost method of continuous, automatic and accurate boiler water level control in one simple compact unit. Once installed and set for operation, no further attention is necessary—nothing to get out of order—nothing to rust.

HENSZEY *Boiler Feed* REGULATORS

help avoid the hazards of high, as well as low water levels. They function night and day under all load conditions. If the boiler needs water — the Henszey Regulator delivers just the right amount to maintain proper efficient boiler water levels. Made for pressures up to 600 lbs. and in pipe sizes up to 4 inches.

Send for complete information or contact your nearest Henszey Representative.

HENSZEY COMPANY • Dept. C-4, Watertown, Wis.

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

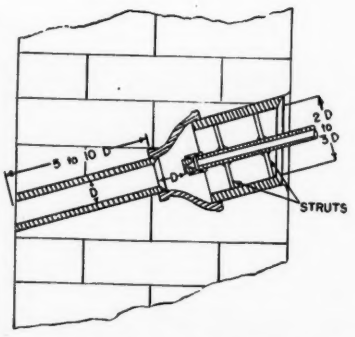


Fig. 11. Method of directing air to steam jet inlet when the best length of air tube is considerably less than the thickness of furnace wall

treated high chromium, or high-carbon steel.

There are two cautions to be observed in connection with the steam-air jet. One is that the air tube should never be smalled than 1 in., and the other is that the nozzle diameter of

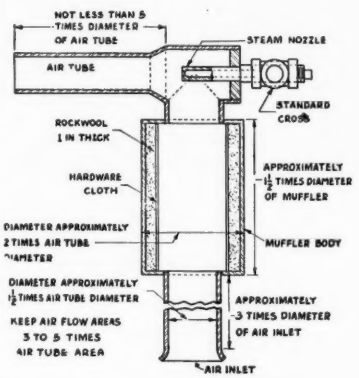

NOT LESS THAN 5 TIMES DIAMETER OF AIR TUBE
STEAM NOZZLE
AIR TUBE
STANDARD CROSS
ROCKWOOL 1 IN THICK
HARDWARE CLOTH
APPROXIMATELY 1½ TIMES DIAMETER OF MUFFLER
DIAMETER APPROXIMATELY 2 TIMES AIR TUBE DIAMETER
MUFFLER BODY
DIAMETER APPROXIMATELY 1½ TIMES AIR TUBE DIAMETER
KEEP AIR FLOW AREAS 3 TO 5 TIMES AIR TUBE AREA
APPROXIMATELY 3 TIMES DIAMETER OF AIR INLET
AIR INLET

Fig. 12. Suggested silencer design

the jet should never be drilled smaller than 3/32 in.

With the steam-air jet the amount of air can be changed by putting in larger or smaller air tubes. To cut the volume of air slip a sleeve into the air tube.

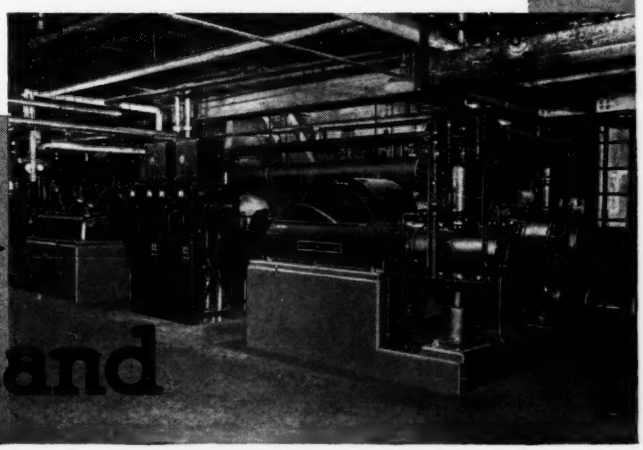
The Plain Steam Jet

In the case of the funace having enough excess air it would be inadvisable to have the air jets installed. But since turbulence is still desired to mix the gases the plain steam jet is used. This is the same as for the steam-air jet except that the size of the air tube is not important. It need only be of sufficient size that the steam nozzle can be removed through it for servicing. The small amount of air that will leak past the nozzle is needed to cool it and prevent burning. Fig. 10 gives the essential proportions to be allowed in the construction of the plain steam jet.

Soot Blowing with *Compressed Air,* particularly automatic blowing, assures systematic operation... thorough cleaning due to air density . . . reduces boiler-tube corrosion and blower maintenance... reduces stack-discharge nuisance... saves feed-water make-up . . . saves fuel . . . saves labor . . . eliminates steam-pipe insulation to blowers. No matter whether for central station, industrial-power, heating, or marine service, your boiler tubes deserve not only the *best* "dusting" you can give them, but also the *most economical.* The answer in your case may be *Air Power.*

Soot Blowing Compressors generally operate at higher pressures than standard and should be engineered to your particular installation. For the most-economical soot-blowing operation Ingersoll-Rand can furnish the correct type.

The I-R trademark on a compressor stands for 75 years of pioneering and development in the compressed-air industry, and for compressors that are dependable, efficient, durable and easy to maintain. It's your assurance of a compressor that is properly built and correctly applied for satisfactory long-life service. Let us help in your planning.



Two 300-hp Type XRE Compressors in an Eastern Central Power Station.

Ingersoll-Rand

79-1 11 BROADWAY, NEW YORK 4, N. Y.

● Where the rate of production and the quality of a product is affected by a cooling process, the NIAGARA AERO HEAT EXCHANGER with "Balanced Wet Bulb" Temperature Control has a remarkable performance record.

For example, by closer control of a quenching bath, it has helped make possible continuous production of precision parts with rejections reduced to the vanishing point and production over double previous performance.

Other applications are cooling of process equipment and engine jacket water, cooling of lubricants, cutting oils, hydraulic oils, electronic sets, transformers, controlled atmospheric processes, condensing of steam, gases and refrigerants, compressed air and gas cooling.

Write for further information and examples of applications in the field that interests you most.

Ask for Bulletin 96-PG

NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

405 Lexington Ave. New York 17, N. Y.

District Engineers in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

WHITING REFINERY

(Continued from page 69)

supplied at 2300 v from switchgear located above the pump bay at the fan floor level.

The ultimate development of the main electrical system will consist of five 13,800-v unit busses, each unit bus being tied through a circuit breaker and reactor to the synchronizing bus. To each unit bus will be connected a 12,500 kva generator and four 6500-kva refinery feeder circuits. The refinery feeder circuits will supply a number of 2500-kva, 13800/4160-v double-ended unit substations on a spot network system, insuring a high degree of reliability in electrical distribution to refinery loads.

The ultimate development calls for three 2300-v station auxiliary busses, each bus supplying the auxiliaries for two boilers. Each 2300-v station auxiliary bus will be fed normally from a 13800-v unit bus through a 6250-v transformer with automatic throw-over to a 2300-v emergency bus supplied from Stanolind Station No. 1. The 440-v station auxiliary busses will be three in number, normally supplied from their respective 2300-v station auxiliary busses through 500-kva transformers with automatic throw-over to a 440-v emergency bus supplied from Stanolind Station No. 1. The electrically-driven station auxiliaries are thus insured of a reliable supply of power, reasonably free from interruption.

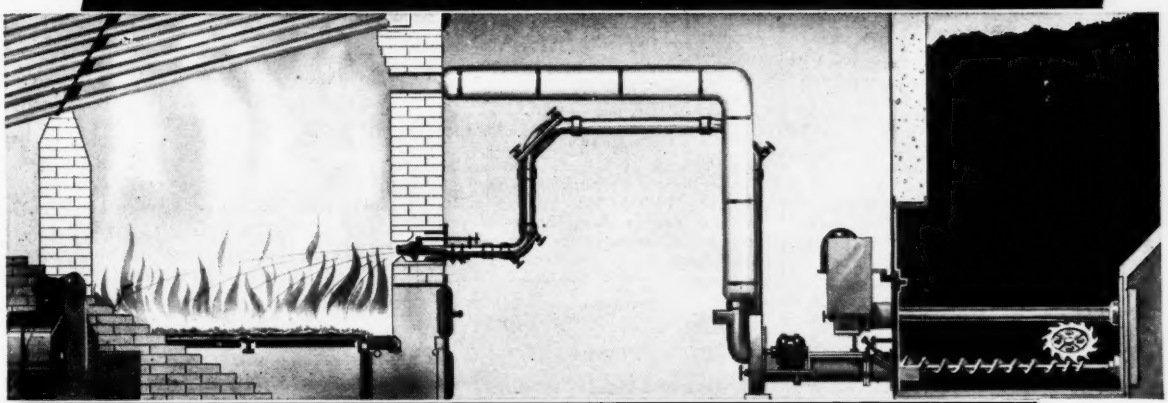
The station lighting is supplied from a 150-kva transformer connected to one of the 2300-v station auxiliary busses. Emergency lights are automatically energized from the 125-v control storage battery.

The principal controls for the station are located on the main operating level. Instruments for controlling boiler operation are mounted on panel boards in the firing aisle in front of each unit. Because of the variable nature of the fuels and the likelihood that two or more fuels will be burned simultaneously, control of combustion conditions will be aided by an oxygen recorder rather than the usual CO_2 recorder. A further aid in maintaining proper combustion will be a smoke indicator and recorder, mounted on the boiler gage boards. The bi-color water level gages will be visable from a station adjacent to the gage boards and a water-level recorder will be provided. A recorder is also being installed to keep a continuous record of the conductivity of the steam leaving each unit. Automatic soot blower controls for both steam and air-puff units are also mounted on the boiler gage boards.

Steam flow meters, master controls, and all controls for the pressure reducing and desuperheating stations, and various pressure and temperature indicators and recorders are mounted on two panel boards installed back to back, to form an enclosed space.

(To Be Continued)

IRON FIREMAN PNEUMATIC SPREADER STOKER



Extracts maximum heat from all grades of coal

*H*ere is a stoker with real *fuel flexibility!* . . a unit engineered to get maximum heat value from a wide range of coals, including the lower cost, economy grades. By its efficient firing of these lower grade economical coals—small size steam coals, sub-bituminous and lignite—this stoker assures steam producers two big advantages: (1) low cost steam; (2) a broad, dependable range of fuel supply. This flexibility partially explains why, every year, more and more steam plant owners are converting to Iron Fireman Pneumatic Spreader stokers. They are *more than stokers.* They constitute *complete firing systems,* embodying bunker pick-up, drying, conveying and highly efficient burning of coal.

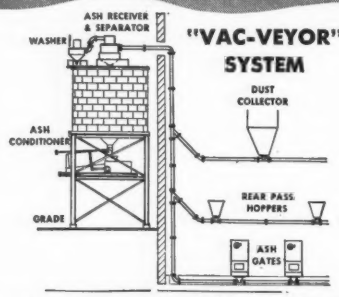
The pneumatic conveying system simplifies installation of the bunker-feed model, regardless of relative positions of coal bunker and boiler. Conveyor nozzle can enter boiler from front, side or rear. Boiler and bunker do not have to be in the same room or even on the same floor level. No costly boiler-room alterations are necessary. Hopper models also available.

For further information, write to Iron Fireman Manufacturing Company, 3215 West 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Dealers everywhere.

IRON FIREMAN
AUTOMATIC FIRING

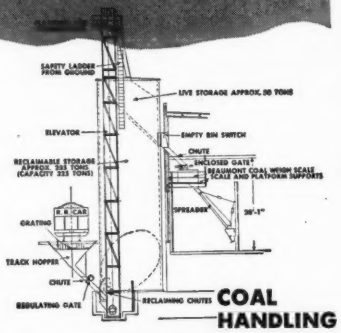
THE IRON FIREMAN

Profits Saved AT EVERY STAGE ... WITH BEAUMONT COAL & ASH HANDLING EQUIPMENT



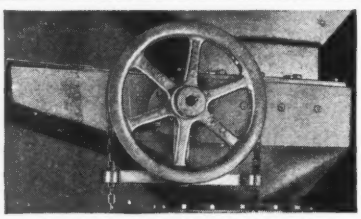
"VAC-VEYOR" SYSTEM

In this system, ashes, siftings, soot and dust are conveyed by pipe from the ash pits, dust collectors, stack, etc., to an ash receiver and separator at the top side of a silo—by means of a vacuum. One man operates the system, keeping your plant cleaner with less labor.



COAL HANDLING

Coal arrives by rail, is dumped into hopper, raised by bucket elevator and discharged either into bunker for immediate use or down chute to yard storage. One operator controls all equipment.

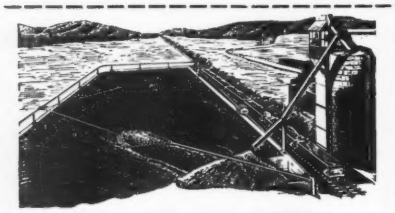


ROLLER BEARING GATE

Incorporating double rack and pinion for granular or powdered materials, these drip-proof self-cleaning gates will not corrode, bend or warp. Material cannot collect in back of gates—these ball bearing gates operate manually or electrically without strain or ramming.

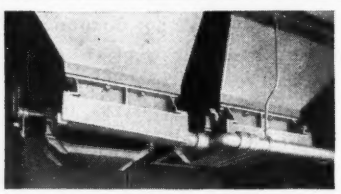
AUTOMATIC WEIGHING SCALE

Accurately weighs coal and similar materials from 1 to 60 tons per hour. Vibrating feeder plate eliminates belts, pulleys and motors. Scale is totally enclosed, dustproof and quiet.



DRAG SCRAPER SYSTEM

Coal is dug evenly with minimum power consumption. Tail blocks can be slung between posts and moved by hand, mechanically moved on I-beam track by tail block car, or suspended from aerial bridge system. One man can operate entire system by remote control.



ASH HOPPERS AND GATES

Steel plate ash hoppers are low cost, rigid, unbreakable, watertight and, when lined with refractory material, resist temperature and erosion. Ash gates are designed for use on stoker and pulverizer ash hoppers where water sealing and draining is essential.

Beaumont engineers design and erect this and associated equipment—*a complete coal and ash handling system.* You save in installation as well as in handling. ONE CONTRACT—ONE RESPONSIBILITY—FOR BULK HANDLING SYSTEMS. Write for more information to:

BEAUMONT BIRCH Company

1503 RACE STREET—PHILADELPHIA 2, PENNA.

Designers Manufacturers Erectors BULK MATERIAL HANDLING SYSTEM

ATOMIC DEVELOPMENT

(Continued from page 71)

power has greater urgency than it has here.

While the actual construction of atomic power plants may be many years away in this country, experimental work in the direction of such plants is going on on many fronts. Sufficient progress has been made to permit the design of medium high temperature reactors using various coolants and moderators, operated at temperatures high enough to produce power on an experimental basis. According to the recent report of the AEC one such reactor (probably the one at Brookhaven) should be in operation by the end of 1950, perhaps earlier.

Many of the problems encountered in finding the working materials for new reactors involve the use of reactors for testing. In addition the Hanford reactors, the AEC has available two reactors at Los Alamos, two at Argonne National Laboratory, and one at Oak Ridge.

These reactors are excellent for the purpose for which they are used: to produce plutonium, to produce isotopes, and for research. No one of them produces usable power and no one of them operates at a high temperature. The "fast" reactor at Los Alamos uses plutonium as fuel. The others are uranium reactors, operating at relatively low temperatures.

The new reactor now being constructed at Brookhaven under the direction of Dr. Borst is a uranium, graphite-moderated, air cooled reactor. Basically, it is similar to the existing reactor at Clinton National Laboratory but it will be somewhat more powerful. It should be in operation in less than a year.

At Argonne, construction is soon to be started on a new type of reactor to be operated at a temperature sufficiently high to make possible the production of useful power. A reactor similar in purpose but of different design at the Knolls Atomic Power Laboratory at Schenectady will provide further information on coolants and permit special studies of both components and power production.

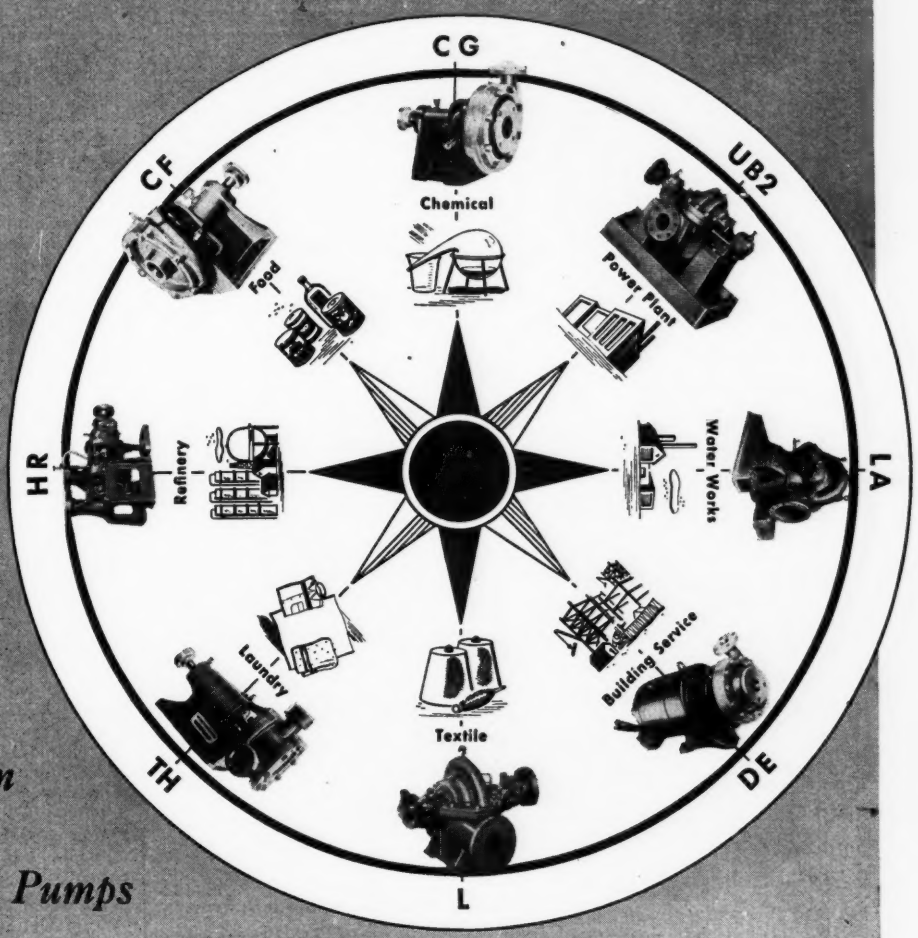
High Flux Reactor for Argonne

Clinton National Laboratory has carried to an advanced stage the design of a high-flux reactor for general research and development purposes. The specifications call for a neutron intensity far greater than is now available and will include provisions for testing reactor components at high temperatures. It will be constructed at Argonne National Laboratory.

General power reactors have been studied at Clinton National Laboratory. The studies completed, thus far, constitute an important store of knowledge of the power problem and

At Every Point On the Industrial Compass

You'll Find Worthington Standard Centrifugal Pumps



Built in a wide range of types and sizes, for all service conditions, Worthington Standard Centrifugal Pumps are found *on the job* wherever you go in industry.

When YOU Choose a Pump . . . Remember that Worthington's complete line and broad experience combine to assure you the *right* pump for the job every time.

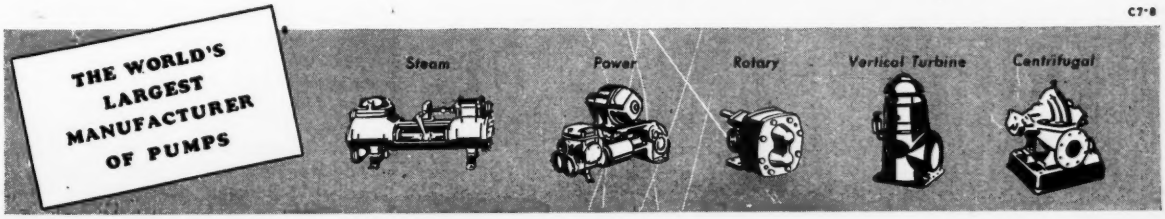
Investigate! It will pay you to learn more about the many advantages Worthington offers. Contact our nearest District Office, or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*

MEMBER

WORTHINGTON

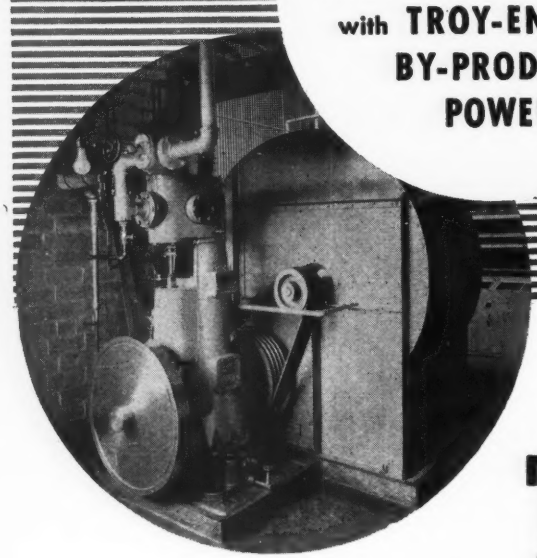
C7-8

THE WORLD'S LARGEST MANUFACTURER OF PUMPS



ARE *You* WASTING BOILER HORSEPOWER ?

GET *Maximum* STEAM EFFICIENCY with TROY-ENGBERG BY-PRODUCT POWER



The modern Troy-Engberg Steam Engine is designed to extract the power from the steam you produce before it passes, with little loss in heating value, into your heating or processing cycles. The steam engine acts as a reducing valve but it's a reducing valve that generates power or drives equipment and then exhausts most of the heat units into your processing or heating lines.

The modern Troy-Engberg Steam Engine also offers the following advantages — wide speed range, high overload capacity, high starting torque, conservative speed, exceptional dependability. Investigate this drive for your stokers, fans, pumps, compressors and generators.

TROY ENGINE & MACHINE COMPANY
(Established 1870)
2100 Railroad Avenue Troy, Pennsylvania

TROY-ENGBERG
STEAM ENGINES • GENERATING SETS • GENERATORS

particularly of components and auxiliaries.

Of course, as the AEC points out, underlying the whole field of atomic energy is the problem of the availability of fissionable materials. The solution to this problem may lie in one or several directions, but one important line of work is the development of a "breeder" a reactor which will create more fissionable material than is put into it as fuel. The word fuel denotes here the fissionable material put into the reactor as the source of energy and of neutrons on which the fission process depends. The material which is put into the reactor for conversion into fissionable material is known as fertile material. If more fissionable material is produced from the fertile material than is consumed as fuel, there would be a net gain or "breeding" of the fuel. The significance of the breeder type of reactor is related to questions of the stores of uranium and thorium in the earth's surface and the economic, political, and technological problems of their recovery.

The accumulation of fuel through the operation of a breeder may be likened to the compounding of interest on money. The initial stock of fuel can be compared to the capital which the depositor puts into a saving account. That capital—in this case fissionable material—is put to work producing power. But at the same time, additional fissionable material (interest on the capital) is accumulating and increasing the original capital.

Thus, it will be seen that there is a complete interlocking of the scientific and engineering problems of the breeder and the *power reactor,* with both heavily influenced by the ability to procure, recover, and process efficiently and with reasonable economy the required fuels.

It will be evident that despite the great amount of effort being expended in all this development work, its diversity, and the periods of time required to produce usable amounts of new fuel through "breeding" introduces a time factor measured in years in any discussion as to when nuclear energy can make a significant contribution to the supply of power. It will require from 8 to 10 years to overcome technical difficulties and have a useful, practical demonstration power plant in operation. On this basis it is quite evident that it will be at least 20 years before we can expect to supply any considerable portion of our power needs from nuclear fuel; undoubtedly, it will be even longer than that.

All this would be wonderful and encouraging, this hope for a world free from worry about power resources, if it could only be divorced from the terrible implications which the development of atomic energy has on the side of destruction. Ironi-

DOUBLE your safety on boiler blow-off..

...with this EVERLASTING team!

As an engineer, you want sure, *doubly-safe* boiler blow-off action. Well, here it is!

This EVERLASTING Duplex Unit consists of two valves . . . a lever-operated "straight-through" type valve (on left) and a wheel-operated angle-type valve.

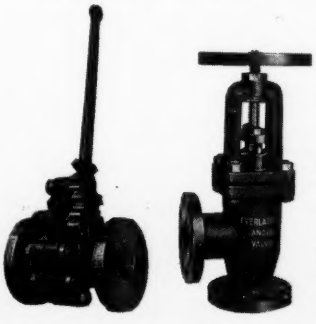
The "straight-through" type opens with about a quarter-turn of the lever, giving you wide-open, full-pipeline flow. And you can forget the worry of corrosive and abrasive action, for this valve is so designed that no damaging grit can lodge between the seat and the sealing disc. The rotating, self-lapping action of the sealing disc against the seat—as the disc moves across or away from the port—provides a *more lasting seal* than you'll find in any ordinary valve. In fact, the more the valve is used, the more this rotating, self-lapping action *improves the drop-tight seal!*

The angle-type valve is stoutly built to withstand the blow-off shock. It takes the punishment, all right . . . *and endures!* Abrasive solids cannot work their costly damage in this valve either — there are no pockets where abrasives can lodge. You get long-time, low-maintenance service!

Maintenance cost of these EVERLASTING Valves is practically nothing. And remember, it's a team that *doubles* your safety factor.

Conforming to A.S.M.E. and other codes for boiler blow-off service, EVERLASTING Valves are made in sizes 1½", 2" and 2½", for pressures up to 600-lbs. Either valve is available separately, in cast iron, or cast steel.

You can have complete information without obligation. *Just drop us a postcard — today!*



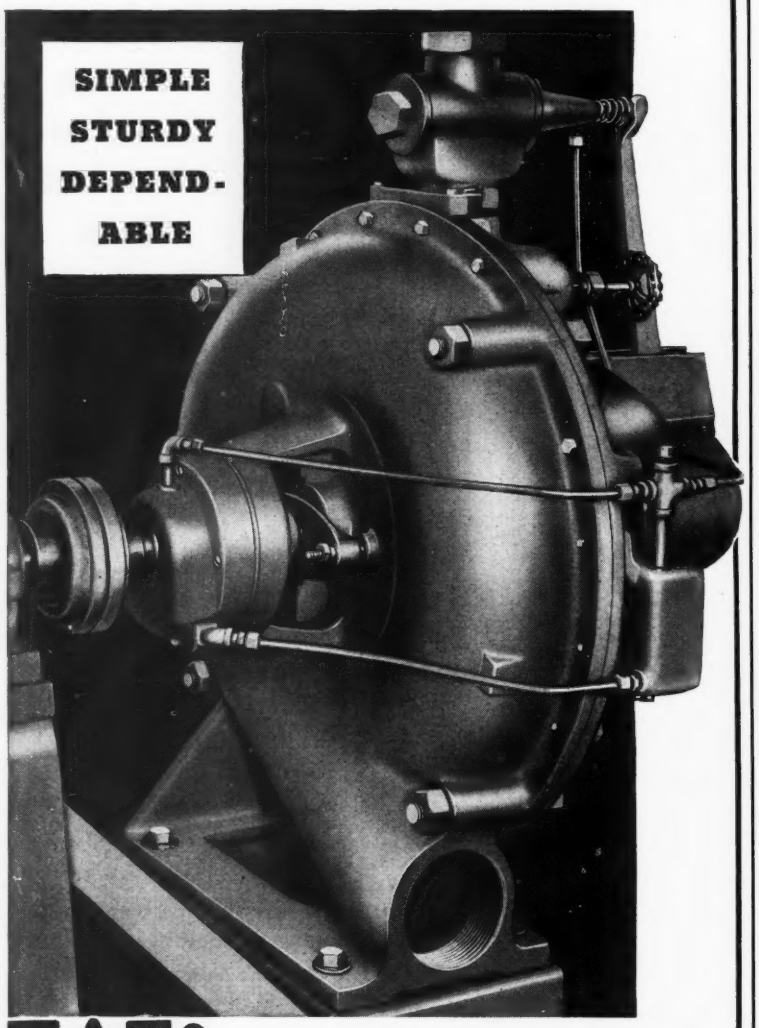
Left view shows the EVERLASTING "straight-through," rack-and-pinion type — the SEALING valve.

Right view shows the EVERLASTING angle-type — the BLOWING Valve.

EVERLASTING VALVE COMPANY
49 Fisk Street, Jersey City 5, N. J.

EV-319

Everlasting Valves GIVE "EVERLASTING" SERVICE



Wing AUXILIARY STEAM TURBINES

FOR DRIVING FANS, BLOWERS, PUMPS, COMPRESSORS, GENERATORS, STOKERS, WINCHES, etc.

FEATURES:
CAPACITIES—up to 150 h.p.
SPEEDS—up to 4,000 r.p.m.
Capable of Exhausting against HIGH BACK PRESSURES
SHAFTS—Horizontal or vertical
ROTATION—Clockwise or counter-clockwise
LUBRICATION—Wing Filtered Oil Lubricating System or Grease
GOVERNOR—Overspeed trip and Speed Regulating
OIL-FREE EXHAUST STEAM may be used for heating or process work.

Write for Bulletin

L. J. Wing Mfg. Co. 64 Seventh Avenue, New York 11, N. Y.
Factories: Newark, N. J. and Montreal, Canada

TURBINE BLOWERS • TURBINES • • FANS • MOTOR DRIVEN BLOWERS
REVOLVING UNIT HEATERS • UTILITY HEATERS • FIXED DISCHARGE UNIT HEATERS
DUCT FANS • DRAFT INDUCERS • HEATER SECTIONS • SHIP VENTILATORS • FOG ELIMINATORS

cally, most of this research, most of the millions now being spent, is primarily because of the significance of atomic energy in the development of weapons. The power aspects, the developments in biological research, etc., are all by-products of the search for new weapons. If it were not for the "weapon" aspect, there probably would be no Atomic Energy Commission nor would hundreds of millions of dollars be available for the construction and operation of the great National Laboratories.

The Moral Issues

And that is why, among the scientists doing the fundamental research, there is considerable apprehension, even self-criticism. Scientists feel keenly their responsibility in bringing atomic weapons into existence. As pointed out by Dr. Oppenheimer himself, nowhere is this troubled sense of responsibility more acute, and nowhere has it been more prolific, than among those who participated in the development of the atomic bomb. There is little doubt that other technical developments, notably radar, played a more decisive part in determining the outcome of the war but those who participated in the development of radar do not feel the deep sense of trouble and moral concern that is felt by those who were active in the development of the atomic bomb. It is not hard to understand why this is so. The physics which played the decisive part in the development of the atomic bomb came straight out of the scientific laboratories and the scientific journals. Despite the vision and the farseeing wisdom of our wartime heads of state, the physicists felt a peculiarly intimate responsibility for suggesting, for supporting, and in the end, in large measure, for achieving, the realization of atomic weapons. Quoting Dr. Oppenheimer, "Nor can we forget that these weapons, as they were in fact used, dramatized so mercilessly the inhumanity and evil of modern war. In some sort of crude sense, which no vulgarity, no humor, no over-statement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose."

URANIUM ORE FROM BELGIAN CONGO

A NEWSPAPER report from Brussels recently announced that the United States had purchased 3650 tons of uranium ore from the Belgian Congo in 1946 at a cost of $5,332,000. Great Britain purchased 2600 tons for the equivalent of $4,250,000.

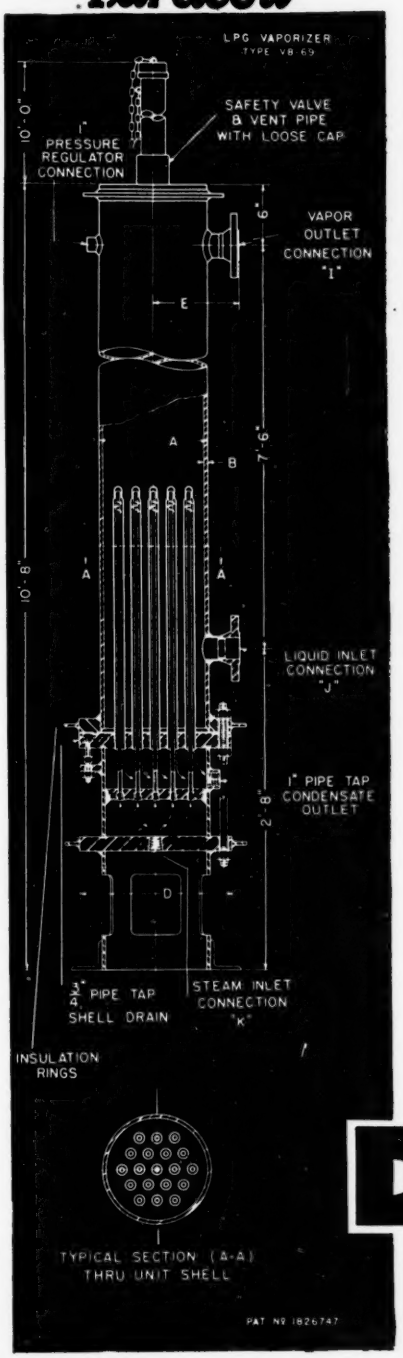
ATOMICS

"HOT PLATE" LPG STEAM VAPORIZER

TRADE MARK REGISTERED

for Medium and High Capacity L. P. G. SYSTEMS

Paracoil


LPG VAPORIZER
TYPE V8-69
SAFETY VALVE & VENT PIPE WITH LOOSE CAP
1" PRESSURE REGULATOR CONNECTION
VAPOR OUTLET CONNECTION "I"
LIQUID INLET CONNECTION "J"
1" PIPE TAP CONDENSATE OUTLET
¾" PIPE TAP SHELL DRAIN
STEAM INLET CONNECTION "K"
INSULATION RINGS
TYPICAL SECTION (A-A) THRU UNIT SHELL
PAT. NO. 1826747

When plant site weather conditions are sufficiently severe as to indicate the use of a Vaporizer with your L.P.G. system, the Paracoil "Hot-Plate" Steam Vaporizer offers operating advantages possessed by no other unit.

FEATURES

- **PATENTED "HOT-PLATE" NON-FREEZING CONDENSATE DRAINAGE SYSTEM.**
- **Installed Above Ground—Entirely Outside the Storage Tank. Can be used with Any Type of L.P. Gas.**
- **High Output Capacity—Up to 1000 Gallons Per Hour Per Unit.**
- **SUPERHEATING OF L.P. GAS IN VAPOR PHASE IMPOSSIBLE.**
- **Fully Automatic in Operation.**
- **No Moving Parts—Nothing to Get Out of Order.**
- **Fitted with Approved Type Relief Valve.**
- **No Vaporizer Flames Used—Operates on Low Pressure or Exhaust Steam.**
- **Easy Access to Heating Surface for Inspection.**

DATA

SIZE NO.	CAPACITY GALS./HR.	A	B	D	E	K	I	J	SAFETY VALVE SIZE	WEIGHT LBS.
H-24S	125	10¾	.365	15⅛	9½	1	2	2	1½	770
K-24S	200	12¾	.375	17¼	10½	1	2	2	1½	1100
L-24S	300	14	.375	18½	11¼	1	2	2	1½	1260
N-24S	500	16	.375	20½	12½	1½	2	2	1½	1590
T-24S	1000	22	.375	26½	16	2	2	2	2½	2690

All Dimensions in Inches — Dwg. 1-14568-B

SPECIFICATIONS

MATERIAL

Outer Shell	—Seamless Steel Pipe
Outer Vaporizing Tubes	—⅞" OD 16 BWG Seamless Steel
Inner Steam Conveyor Tubes	—½" OD x 20 BWG Seamless Aluminum
Tube Sheets and Flanges	—Rolled Steel Plate
Steam and Condensate Channels	—Welded Steel
Supporting Base	—Welded Steel

DESIGN

A.S.M.E. Code, Par. U-69
N.B.F.U. Pamphlet No. 58, Spec. B.10.i

Working Pressure:	Shell	250 PSIG	(Liquid Vapor Side)
	Tubes	200 PSIG	(Steam Side)
Test Pressure:	Shell	500 PSIG	Hydrostatic
	Tubes	400 PSIG	Hydrostatic

Liquid Inlet Connection — 300 Lb. Design
Vapor Outlet Connection — 300 Lb. Design

ASME CODE CONSTRUCTION—HARTFORD INSPECTED
MEETS ALL N.B.F.U. REGULATIONS
WRITE FOR ENGINEERING DATA AND PRICES

DAVIS
ENGINEERING CORPORATION

1063 East Grand Street, Elizabeth 4, New Jersey

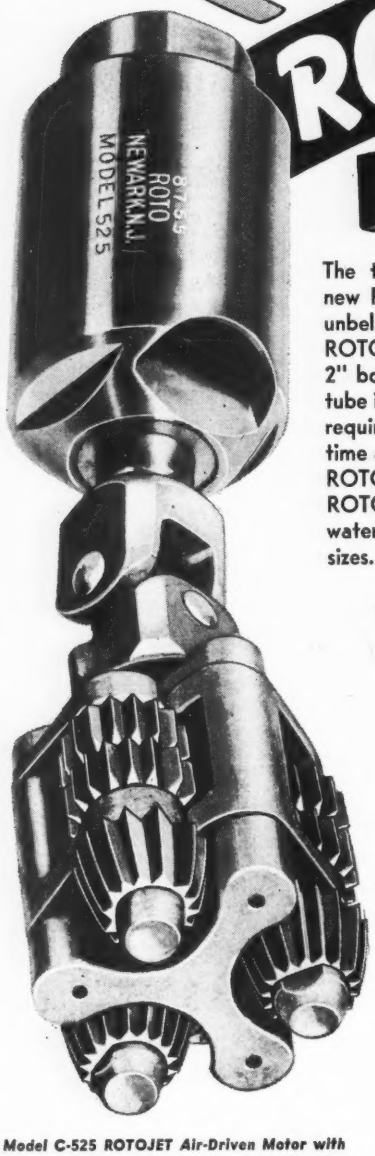
30 Rockefeller Plaza, New York 20, N. Y.

Unequalled Speed

IN THE AIR

ROTOJET

for tube cleaning



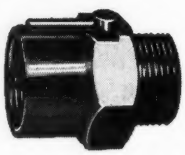
Model C-525 ROTOJET Air-Driven Motor with swing frame head and universal joint for 2¾"—3½" I.D. curved tubes.

The tremendous power developed by the new ROTOJET enables it to clean tubes at unbelievable speed. On one recent job, a ROTOJET Model 505 cleaned badly scaled 2" boiler tubes at the rate of 5 minutes per tube in one pass, while ordinary tube cleaners required two passes and 20 minutes. The time and labor saved more than paid for the ROTOJET on this one job alone. New ROTOJET models for operation with air, water or steam are stocked for most tube sizes. Send for new bulletin.

ROTOJET

Air-driven

TUBE CLEANERS



Roto Air Valve for curved tube cleaners.

Roto Air Valve Saves Labor

By installing an inexpensive Roto Air Valve directly behind the motor, tube cleaning becomes a one-man job, eliminating a helper and speeding up the cleaning. Made for all straight and curved air-driven tube cleaners.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue Newark 1, N. J.

WHY TURBULENCE IS IMPORTANT TO ENGINEERS

(Continued from page 51)

not directly concerned with the behavior of the propelling jet after it leaves one of the modern jet planes, the problem became of immediate importance to the Navy during World War II, when it was found that the passage of a ship could be detected some time (10 minutes or more in some cases) after the ship had passed. The diffusion of a submerged spillway jet is of importance to permit the economical design of an apron for erosion prevention, and the designer of a ventilation system is directly concerned with the spreading of the fresh-air jet lest it short circuit and return before accomplishing its mission. Detailed studies of the spreading and dissipation of the jet have been made, both because of such practical applications and because of the excellent opportunity afforded to investigate the interrelationship of the parameters of turbulent flow.

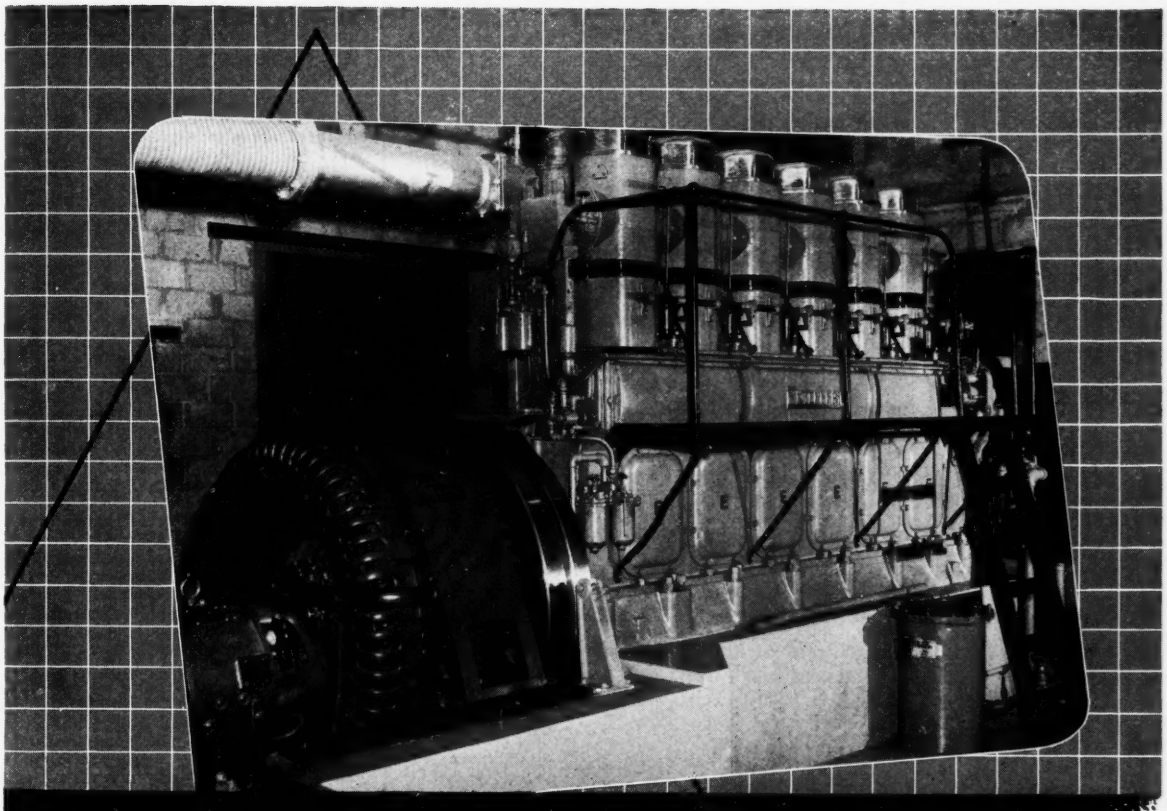
Other Analysis

Other analyses of turbulent motion somewhat further afield from engineering have been made recently, one by Dr. Rossby of the Department of Meteorology at the University of Chicago and the other by Dr. Munk of Scripps Institute of Oceanography. Dr. Rossby explained some of the unusual mixing processes found in the atmospheres of both the earth and the sun by analyzing the turbulent motion in a very thin spherical shell representing the earth's atmosphere. Dr. Munk related a number of formerly disconnected occurrences on the basis of a change from laminar to turbulent motion in the boundary layer immediately above the surface of the ocean.

The examples just cited are representative of problems that have been solved with worthwhile results. Another list could be made of problems to which the solutions are urgently sought. A river engineer would place at the top of his list a quantitative solution of the process whereby sediment is lifted from the bottom of the river and carried in suspension. At the top of the river, turbulence plays an important—but so far indeterminate—role in the process of evaporation from the water surface.

A third unsolved phase of turbulent motion that is of primary importance is the development of the turbulent boundary layer.

Although there are many additional problems in which turbulence plays a major role, it is felt that the foregoing illustrations will serve to indicate both the intricacies and the tremendous scope of this phase of fluid mechanics.



This Enterprise Diesel Generating Plant brought drastic rate reductions to electric users in Carlin, Nevada

. . . Rates Slashed up to 50%!

November 20, 1947 was a big day in Carlin, Nevada. On that day the four heavily overloaded generator units, three of them quite old, were relieved by the Enterprise DSG-6 Diesel you see above. On that day all the rigid restrictions governing the use of municipal electricity were removed. Residents and commercial users alike breathed a sigh of relief, knowing that their new power plant could easily serve all their needs—with plenty of reserve to take care of the town's future growth.

That's just a *part* of the story.

L. T. Doxey, Carlin's Town Clerk, wrote us in behalf of the Council on February 16, 1948: *"We are pleased to advise you of our new and lower light and power rates. These rates were made possible due to the improved engine operating conditions brought about when our plant was redesigned and the Enterprise Diesel Engine was installed. The increased efficiency of this new engine over the older units, plus the increased KW output of the plant, is responsible for this savings to our consumers."*

Carlin's new sliding-scale rates show savings to consumers that range up to 50%. With a higher KW capacity than ever before—275 KW, fuel consumption has dropped 2,000 gallons a month.

Your community—or plant—can expect this same high degree of efficiency and savings when you specify ENTERPRISE Diesels to meet your replacement or expansion needs.

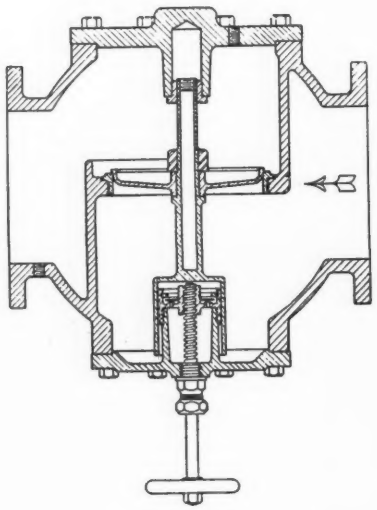
Choice of Power Experts . . . Everywhere

ENTERPRISE ENGINE AND FOUNDRY CO.

18th and Florida Sts.
San Francisco 10, Calif.

Offices in Principal Cities

CONDENSER RELIEF VALVES



A DAVIS Specialty!

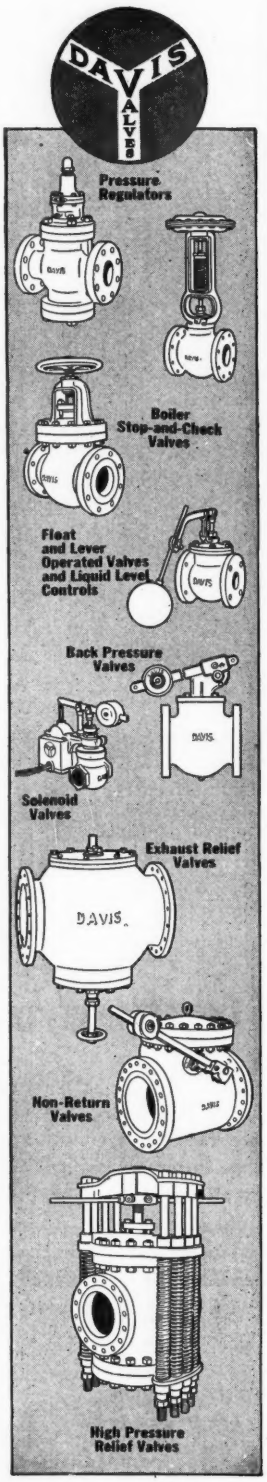
DAVIS specializes in building atmospheric exhaust relief valves to meet the modern needs of power plants for protective equipment. The Davis No. 110 Relief Valve, shown in cross-section above, is one of the several widely-used Davis designs that give engineers what they want for condenser protection.

No. 110 features a quick opening and cushioned closing action. The bronze-to-bronze-contact valve is water-sealed through inlet and overflow pipe connections in the body. It holds tight under high vacuum to prevent air infiltration into the condenser and relieves to atmosphere at a fraction of a pound pressure when for any reason the vacuum is lost. Shown here with hand lift at bottom, it is also available with hydraulic lift.

The Davis line of exhaust relief valves is complete. Sizes from 6" to 48". Horizontal, vertical, or angle body patterns. For detailed information, ask for Bulletin No. 101A.

No. 110 Exhaust Relief Valve

Left.—Davis has brought the atmospheric relief valve to a high point of perfection, with a combination of engineering features not found elsewhere.



DAVIS REGULATOR CO.

Representatives in All Principal Cities

2508 S. WASHTENAW AVE., CHICAGO 8, ILL.

COMING EVENTS

EEI—The 14th Annual Conference of the Edison Electric Institute will be held at the Edgewater Beach Hotel, Chicago April 6-8.

Midwest Power Conference—Tenth annual Midwest Power Conference; to be held in Chicago April 7, 8 and 9, at the Sheraton Hotel (formerly the Continental Hotel).

ASCE—1948 Spring Meeting of the American Society of Civil Engineers to be held in the William Penn Hotel, Pittsburgh, April 7-9.

ASLE—The American Society of Lubrication Engineers will hold its third Annual Convention at the Hotel Statler, Buffalo, New York, April 19, 20 and 21.

Machine Tool Forum—1948 Machine Tool Forum to be held in Buffalo, April 22-23, at the Hotel Statler.

Refrigeration—Second annual Western Refrigeration Educational Exhibit and Conference; to be held in San Francisco April 30, May 1 and 2, at the Palace Hotel.

Stress Analysis—The Annual Meeting of the Society for Experimental Stress Analysis to be held at the Roosevelt Hotel, Pittsburgh, on May 27, 28 and 29.

Surface Reactions—The Pittsburgh International Conference on Surface Reactions will be held at the Mellon Institute for Industrial Research in Pittsburgh, June 7-11.

ASCE—1948 Summer Convention of the American Society of Civil Engineers to be held in the Olympia Hotel, Seattle, July 21-23.

Instrument Society—Instrument Society of America annual meeting to be held in Convention Hall, Philadelphia, September 13-17.

ASCE—1948 Fall Meeting of the American Society of Civil Engineers to be held in the Statler Hotel, Boston, October 13-15.

ALLEVIATING A POWER SHORTAGE

To HELP alleviate a power shortage in the Imperial Irrigation district in California which would affect harvesting and processing of crops during the next four months, the Board of Water and Power Commissioners of Los Angeles have made available to the district 5,000,000 kw-hr of surplus energy from the Los Angeles municipal electric system.

Because the Department of Water and Power has no power connection with the District, the surplus power is being sold to the California Electric Power Co., which will deliver the energy to the District.

The department is supplying California Electric through an interconnection with the company at the department's Seal Beach steam plant in Seal Beach.

The contract is effective immediately and will extend to May 1. Power deliveries will be made in amounts and at times specified by the department. According to the terms of the contract, power will be billed on a basis of $1.25 per kw of highest monthly 30 minute maximum demand during the month or any previous month plus a charge of 0.0068 cent per kw-hr.

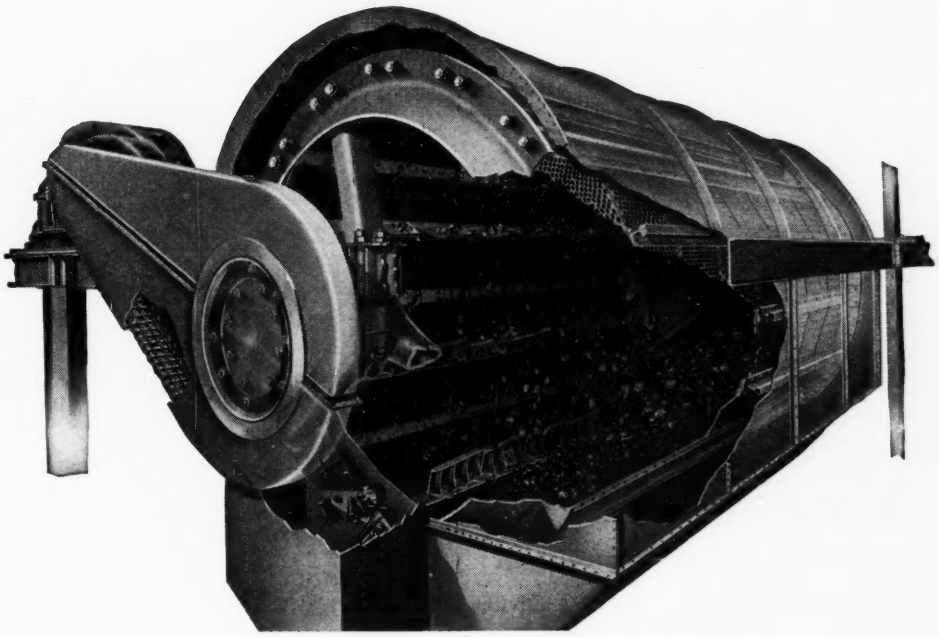
BOILER WATER TREATMENT FILM

E. F. DREW & CO., INC., has prepared a ten minute sixteen millimeter motion picture film with sound entitled "A Study in Boiler Water Treatment" and are offering this picture without charge to engineering societies and other interested groups.

The picture was filmed in the Drew

"PENNSYLVANIA" STEELBUILT

BRADFORD BREAKERS at the POWER STATION



Prepare Uniform Steam Coals . . .
Without Oversize . . . with Minimum Fines

The flexibility and dependability of the "Pennsylvania" Bradford make it the ideal power station crusher. It has the flexibility needed to handle rail, tidewater and storage coals, soft, medium and hard, from all sources, at all seasons of the year. It is a dependable scavenger—protects stokers, pulverizers and conveyors from mine refuse, tramp iron and other debris. Its stamina and dependability make single unit installations sound engineering practice. In fact, more than 65% of all "Pennsylvania" Bradfords in central station service are single units, the multiple units in most cases being installed for capacity reasons. Such reliance on a single piece of equipment at an important Central Station was unthinkable prior to the "Pennsylvania" . . . is the sincerest tribute to the engineering skill and massive construction that go into this unit.

At the power station it is often necessary to reduce wet coals, from barges or stock piles. In temperate zones such coals will be frozen for weeks and months at a time. For such services the "Pennsylvania" is supplied with "Laclede Special" screen plates which have somewhat increased screening capacity on dry coals and are practically non-clogging and self-cleaning when handling wet or frozen coals.

This unit has become almost the standard primary crusher at power stations throughout the country because of its dependability in service, the unusually small amount of power required, the negligible amount of maintenance and servicing necessary and the fact that the delivered product is completely free from oversize and all refuse larger than the screen perforations.

"Pennsylvania" Steelbuilt Crushers are first choice in Power Plant and Coking Plant equipment, here and abroad. Types and capacities to meet all requirements. Inquiries are invited.

PENNSYLVANIA CRUSHER COMPANY

Liberty Trust Bldg., Philadelphia 7, Pa.

New York • Pittsburgh • Chicago • Los Angeles • Birmingham

Associated with Fraser & Chalmers Engineering Works, London

Before and After Views Show How

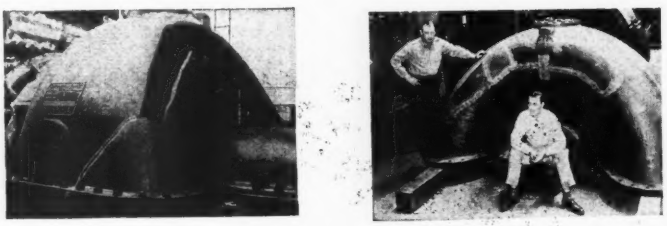
METALOCK REPAIRS

Put Power Equipment Back in Production Quicker, at Lower Cost

Study these views of broken and cracked frames and cylinder blocks. They will give you an idea of the big savings in time and money Metalock casting repair service is delivering in plants all over the country. . . . Metalock repairs, made only by workmen thoroughly trained in this patented process, have been proved and accepted by manufacturers, users, underwriters.

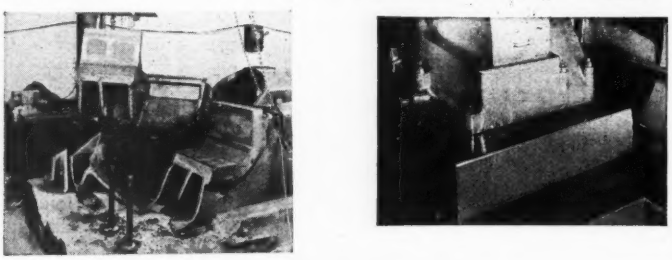
10,000 KW. STEAM TURBINE

Before **After**



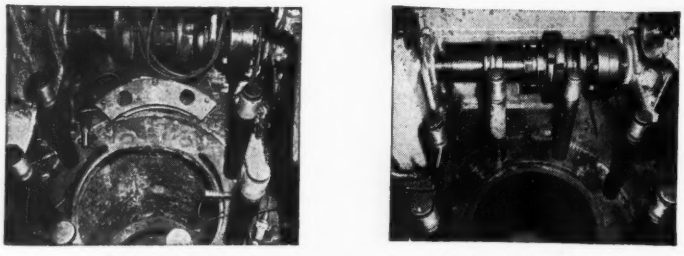
LARGE COMPRESSOR FRAME

Before **After**



32 IN. DIA. DIESEL ENGINE BLOCK

Before **After**



Send for FREE Illustrated Metalock Booklet No. 104 Showing 50 Typical Illustrations. Service in any part of U.S.A., Canada, England, Norway. Agents Wanted.

METALOCK REPAIR SERVICE, Inc.

Home Office: 36-15 48th Avenue, Long Island City, N. Y.

STILLWELL 6-0330 and 0331

CABLE ADDRESS: "METLOKCAST NEW YORK"

research laboratories at Boonton, N. J. and covers briefly the main difficulties encountered in boiler water treatment such as scale and corrosion and their correction. By means of a 1000 psi foaming boiler, fitted with sight glass, foaming and priming are shown in a manner which closely duplicates these phenomena in a high pressure boiler.

For information concerning the use of this film communicate with E. F. Drew & Co., Inc., Power Chemicals Division, 15 E. 26th St., New York 10, N. Y.

DIRECTORY OF COMMERCIAL AND COLLEGE LABORATORIES

A COMPLETE LISTING of commercial and university testing and research laboratories throughout the country, together with indications of the type of commodities tested, has been compiled by the National Bureau of Standards. This pamphlet is now available from the Government Printing Office as NBS Miscellaneous Publication M187 entitled *Directory of Commercial and College Laboratories.*

As the principal agency of the Federal Government for research and testing in physics, mathematics, chemistry, and engineering, the Bureau makes tests and carries out investigations for other government organizations. However, it does not make tests for private individuals if other laboratories can do the work with the required accuracy. Since inquiries regarding such service are often received, this classified list was assembled to inform interested persons of the location of other testing facilities. It is expected that the directory will also be of value to the large number of purchasers who are not equipped to make their own acceptance tests and have therefore hesitated to buy on specifications.

Information is given concerning 220 commercial laboratories, with 80 branches or offices and 189 college laboratories used for research and testing as well as instruction. Listings are arranged both geographically and alphabetically to facilitate the ready location of any laboratory. Miscellaneous Publication M187 may be obtained only from the Superintendent of Documents, Washington 25, D. C., at 30 cents per copy.

RALPH E. FLANDERS RECEIVES 1948 WASHINGTON AWARD

RALPH E. FLANDERS, U. S. Senator from Vermont, received the Washington award for 1948 at a dinner meeting of the various engineers and engineering societies concerned, held in Chicago on February 11. Following his receipt of the award, Senator Flanders addressed the meeting on Technology and Living Standards.

The Washington Award is made to an outstanding engineer, a citizen or resident of the United States, who has ably served human needs. It is administered by a commission in the interests of five engineering societies: WSE, ASME, AIEE, ASCE, and AIM&ME. Titus G. LeClaire is chairman of the Washington Award Commission.

Senator Flanders has been a leading mechanical engineer, serving as president of Jones and Lamson Machine Co., and associating in engineering capacities with other leading machine tool manufacturers and designers. He has long been interested in economic and social problems and has written many articles on these subjects. He has been active in the affairs of ASME, serving successively as manager, vice president and finally president of the ASME in 1935

How to Revitalize Water Coolers

ARE YOUR evaporative coolers giving below-par performance? Often unsuspected, though frequently at fault is the cooler's water supply.

By treating water the newly-developed Oakite way, you can prevent hard lime scale and slime from interfering with cooler efficiency. Simply add to sump water tank recommended quantity of Oakite Airefiner No. 52. This designed-for-the-job chemical agent keeps lime particles in suspension so that they cannot settle on cooler coils. In addition, Oakite Airefiner No. 52 has potent germicidal and fungistatic properties that discourage slime and algae build-up in tanks, on suction screens, coils and eliminators.

Technical Data FREE

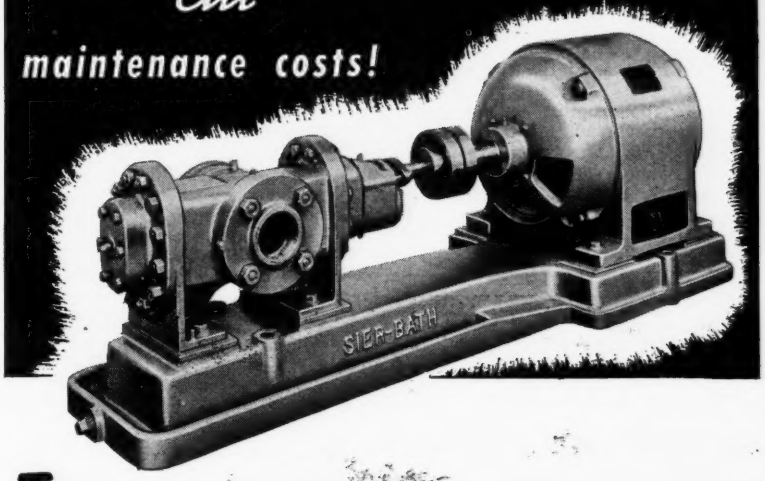
A four-page Oakite Field Service Report giving details on the use of Oakite Airefiner No. 52 is yours for the asking. Drop us a card for your FREE copy today.

OAKITE PRODUCTS, INC.
16C Thames Street, NEW YORK 6, N. Y.
Technical Representatives in Principal Cities of U. S. & Canada

OAKITE

Specialized Industrial Cleaning
MATERIALS • METHODS • SERVICE

SCREW PUMPS built to SIER-BATH accuracy *cut* *maintenance costs!*



The high quality of design and construction of Sier-Bath Screw Pumps enables them to operate continuously for long periods without maintenance. The pulseless flow and vibrationless operation of these pumps greatly reduce maintenance cost—there is less wear on valves, couplings and other fittings. Pipes and joints remain tight and require little attention. With maintenance labor costs at an all-time high, these are important points to consider today in the selection of pumps.

Made in an up-to-date machine shop, accustomed to precision methods and equipped with the most modern machinery, Sier-Bath Screw Pumps always measure up to the highest standards required by users. They are made in both horizontal and vertical models.

Sier-Bath customers are protected from mis-application by the mature pump engineering experience of this Company's staff. Send for descriptive booklet.

ADVANTAGES:
● pulseless flow ● anti-friction bearings ● vibrationless operation
● low maintenance cost ● rugged construction

PUMPS: Acetate, asphalts, brines, Bunker C Fuel Oil, Cellulosics, Greases, Molasses, Syrups, Lube Oils, etc.

FOUNDED 1905 **MEMBER A.G.M.A.**

★ Also makers of Sier-Bath Gearex Pumps and Sier-Bath Precision Gears.

Sier-Bath
GEAR and PUMP CO., Inc.

9256 HUDSON BLVD. **NORTH BERGEN, N. J.**

PREVENTING SUPERHEATER TUBE FAILURES DURING STARTING-UP PERIODS

OCCASIONALLY a tube in a pendant type of superheater will become badly overheated and will fail shortly after the boiler has been fired following a shutdown period. Then, if none of the usual conditions leading to a tube rupture is in evidence, it may be difficult to determine the exact cause of the failure. Quite a few occurrences of this kind have been reported in recent years and the facts about two investigations that were concluded not long ago are interesting.

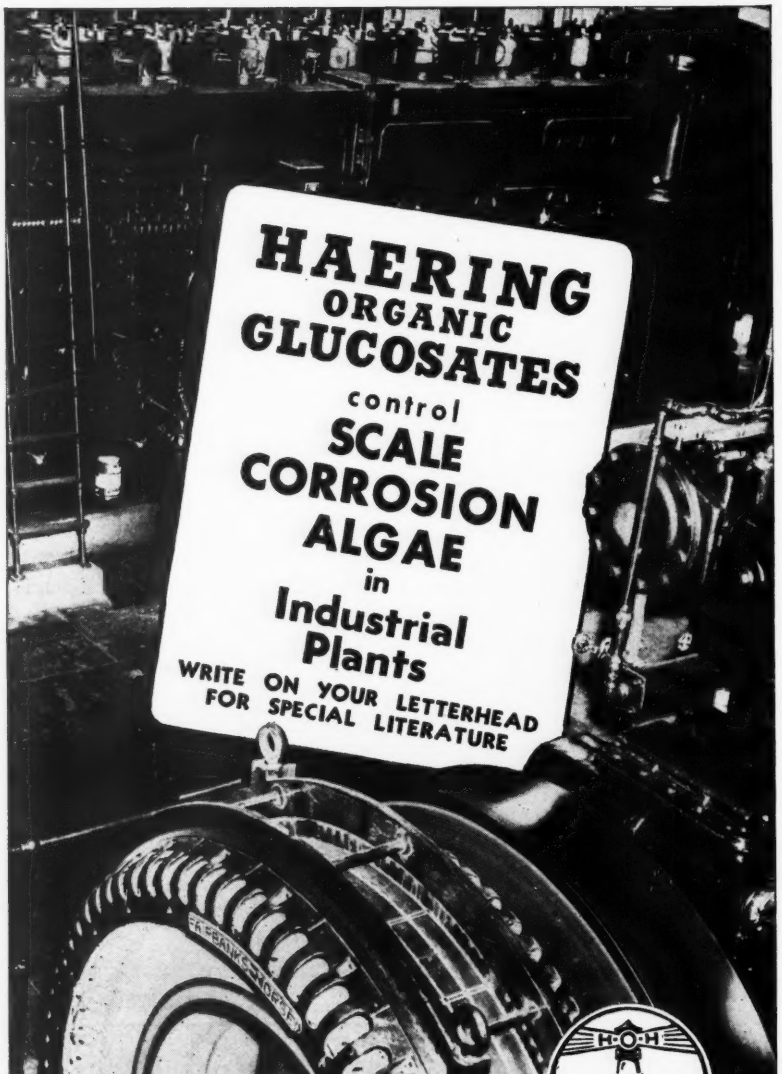
One of the boilers involved in the study was a large unit in a central station, and trouble with the superheater tubes began shortly after the boiler had been newly installed. Prior to the epidemic of failures, however, performance tests made by the manufacturer had disclosed that the final temperature of the superheated steam was in excess of the plant's requirements, and in order to reduce the steam temperature, several blocks had to be removed from the bottom part of the baffle wall between the bank of screen tubes and the superheater, thereby permitting the by-passing of some of the gases around the superheater. Up to that time, no difficulty other than excessive superheat had been experienced and the by-passing of the gases brought about the desired decrease in superheat. However, when the boiler was placed in service to carry part of the plant load, the trouble with superheater tube failures began, as narrated in the following, in a recent issue of *The Locomotive*.

All of the tubes that failed were located in the front of the superheater, and the failures were for the most part confined to the tubes on each end of the unit. All failures occurred just above the baffle wall and all of the affected tubes showed evidence of rapid overheating. It was also observed that the occurrences almost invariably happened shortly after the boiler was placed in service following a shutdown.

Thermocouples were placed at the gas inlet to the superheater pass for obtaining the temperature to several of the entering gases, and additional thermocouples were attached to several of the superheater tubes to check the tube-wall temperatures. While the usual plant procedure of putting the boiler on the line from a cold start was being followed, observations revealed that some of the superheater tubes still contained water several hours after the fires had been lit. In some cases the water was not evaporated until after the boiler had been placed under load. It was therefore obvious that the tube failures were caused by the "blocking" of steam flow through the elements in which water had been trapped and by too rapid firing. The trouble was overcome by removing some of the superheater elements to decrease the temperature of the superheatd steam, closing the openings made in the baffle wall and establishing an approved firing procedure to be followed when the boiler was being placed in service.

Similar trouble was encountered at a municipal plant in which a large modern boiler had been installed to replace several old ones. It had been the custom in that plant to force the old boilers when they were being put on the line, but when that practice was carried out with the new unit, a superheater tube failed. The area of rupture in the tube was just above the baffle between the screen tubes and the superheater. It was at first thought that the low carbon steel tubes in the superheater had been heated beyond a safe operating temperature, so in order to reduce the rate of heat input into the upper parts of the tubes, the height of the baffle wall between the screen tubes and the superheater was lowered about two feet. This did not correct the trouble but merely transferred the area of failure about two feet lower on the tubes.

The investigation of this case disclosed that just as in the previous example, practically all of the occurrences happened shortly after the

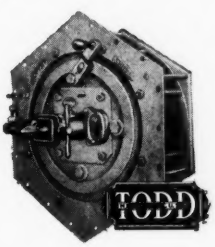


OIL ALLOTMENTS GO FURTHER WITH TODD BURNERS

★

● Stretch your oil supply by replacing obsolete equipment with Todd Burners. Avail yourself of the years of experience of Todd engineers.

Oil Burners
Gas Burners
Combination Oil and Gas Burners



COMBUSTION EQUIPMENT DIVISION

TODD SHIPYARDS CORPORATION

81-16 45th Ave., Elmhurst, Queens, N. Y.

NEW YORK • BROOKLYN • ROCHESTER
HOBOKEN • NEWARK • PHILADELPHIA
HARRISBURG • YORK • CHICAGO • CHARLESTON, S. C. • BOSTON • SPRINGFIELD, MASS.
BALTIMORE • WASHINGTON • DETROIT • GRAND RAPIDS • TAMPA • GALVESTON • MOBILE • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO
SEATTLE • MONTREAL • TORONTO
BARRANQUILLA • BUENOS AIRES • LONDON

boiler was placed in service. Thermocouples were installed on several of the superheater tubes in the front row and at the entrance of the gas passage to the superheater. Observations made while the boiler was being brought up to pressure revealed that the tube wall temperatures, especially of some tubes close to the side walls, approximated that of the gases entering the bank. The condition was most noticeable when the firing rate was materially increased.

Superheater tube failures in this boiler were finally prevented by following an operating procedure designed to keep the temperature of the gases entering the superheater at a minimum until all of the water that was trapped in the loops had been evaporated, and by increasing the size of the superheater drain.

An analysis of the data obtained in making a study of these two boilers, as well as other boilers where similar trouble has been encountered, indicates that tubes in the high temperature areas, especially in the center of a pendant type superheater, are boiled free of water first, but by so doing a pressure may be set up in the headers so that the water in the other superheater tubes cannot be blown out unless the firing rate is properly controlled. It is true that the water in the "blocked" elements will acquire a high temperature that would evaporate the water at low pressure, but because of the high pressure imposed on it by the superheated steam in the headers, that water may remain in the tubes as water. Since there is no steam flow through such tubes, the tube wall areas that are not protected by water are liable to become overheated.

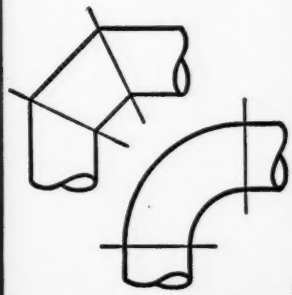
Superheater tube failures of the kind mentioned above may take place in boilers where the following factors are present:

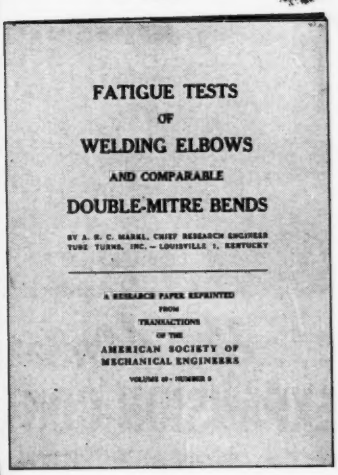
1. Boilers equipped with superheaters directly exposed to the radiant heat of the furnace;
2. Boilers designed with one or two rows of screen tubes located between the furnace and the superheater.
3. Boilers having superheaters from which elements have been removed to reduce the degree of superheat and where by-pass connections have been installed between the inlet and outlet superheater headers to reduce the pressure drop across the superheater.

Water in the superheater elements may exist because:

1. Precautionary measures have not been taken to blow out the water after a boiler has been subjected to a hydrostatic test;
2. Condensation has been collected after the boiler has been removed from service;
3. In some plants it is the practice to flood the superheater before firing the boiler.

WHICH? and Why




FATIGUE TESTS
OF
WELDING ELBOWS
AND COMPARABLE
DOUBLE-MITRE BENDS

BY A. R. C. MARKL, CHIEF RESEARCH ENGINEER
TUBE TURNS, INC. — LOUISVILLE 1, KENTUCKY

A RESEARCH PAPER REPRINTED
FROM
TRANSACTIONS
OF THE
AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

GET THIS BOOK

Fatigue Tests of Welding Elbows and Comparable Double-Mitre Bends: This research paper gives the authoritative pro-and-con. Analyzes effects of bending in the plane and transverse to the plane of curvature, and bending with and without internal pressure. Mail the coupon.

TUBE-TURN TUBE-TURN — *T. M. Reg. U. S. Pat. Off.*

WELDING FITTINGS AND FLANGES

District Offices at New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Tulsa, San Francisco, Los Angeles

Tube Turns, Inc., Dept. 4308, Louisville 1, Kentucky

Please send "Fatigue Tests" booklet.

Name.....
Position.....
Firm Name.....
Street.....
City.....*Zone*....*State*.....

HOW TO MAKE INDUSTRIAL STEAM PLANTS PAY

(Continued from Page 63)

ance ratio. Use of the system has invariably led to fuel reductions of 10 per cent to 15 per cent. Maintenance method changes increase profits by the use of maintenance planning, scheduling, and control systems.

How to Justify Modernization?

Occasionally, equipment modernization can be justified by operating cost reductions. The economic analysis of an example is shown in Table II.

Table V. Investment analysis of steam plant systems involved in a plant for 50,000 lb per hr steam capacity, pressure 150 psig

Systems	Labor & Material $	Investment Cost Unit $/Lb./Hr. Steam Capacity
I—Steam Generating	79,887	1.597
II—Fuel Handling & Storage	37,783	.756
III—Dust & Ash Handling & Storage	9,466	.189
IV—Feedwater System	15,425	.308
V—Piping	15,840	.316
VI—Electrical Wiring	5,610	.112
VII—Instruments & Controls	7,416	.148
VIII—Building	8,027	.160
IX—Misc. Equipment	180	.004
	$179,634	3.590

In the example, existing equipment requires high grade coal and uses labor inefficiently. Maintenance costs are high. A survey developed the cost-reduction possibilities shown by changing the boiler furnace from an air-coled-refractory, pulverized-coal-fired unit, to a waterwall spreader-stoker-fired unit and by providing pneumatic ash-handling equipment to replace the manual ash removal method. Savings resulted from increased boiler efficiency, use of lower priced fuels, less labor, less maintenance, and less motive power. Note the net return. *Initiating this type of economic analysis is the operator's responsibility.*

Records Are Vital

The operator influences investment cost through control over the extent and type of service. Here is where adequate metering facilities and records pay their way. Records that define the character and duration of loads, and which clearly show operating costs, are the basic data needed for economic analysis. Load data are essential facts needed by the designers at the start of a plant expansion program. The operator makes demands on the designer and executive when specifying the type of performances expected of new facilities.

Occasionally, these demands which make the operator's job easy at the expense of the stockholder are visionary. Frequently they contain an element of unjustified desire for extra capacity or standby equipment. Here again, it is the operator's duty to analyze these requirements and to determine the financial justification of any requirement in excess of the minimum. Acceptance of new ideas and economic facts is essential if the overall return on plant investment is to be kept at a maximum.

The Designer's Viewpoint

The designer of an industrial steam plant faces three separate requirements which at times seem to conflict with the desires of the executive and the operator. These requirements are:

1. Minimum Investment
2. Minimum Operating Costs
3. Adequate Service without Shutdown

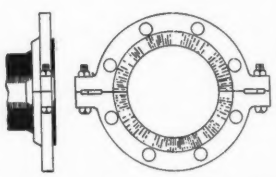
Solution of the problem presented

...*The Modern Way* TO DEFEAT EXPANSION-CONTRACTION, VIBRATION

New principles of construction and operation give Goodall Rubber Expansion Joints superior strength, efficiency and safety, and make them easier to install, than any other type. Available for all standard pipe sizes from ⅜" to 96", I.D. For lines carrying fluids, steam, air or gases, under vacuum or pressure, at temperatures up to 250° F.

"FLANG-LOK" Floating Flanges

Designed to simplify installation of Goodall Expansion Joints at any point in the line. Shaped to accommodate ends of Goodall Expansion Joints, and to assure a positive, non-metallic seal when tightened. Bolt holes are easily aligned by turning flange only. Magnitude of forces making seal is in direct proportion to stress applied to bolts when tightening. Furnished in steel or cast iron.



Contact Our Nearest Branch for Details, or Send for New Folder

GOODALL RUBBER CO., INC.

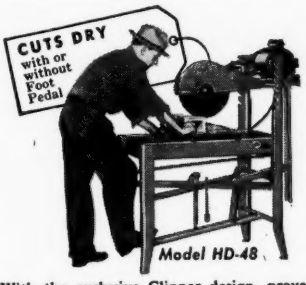
THE GOODALL-WHITEHEAD COMPANIES

Philadelphia • Trenton • New York • Boston • Pittsburgh • Chicago • St. Paul • Los Angeles
San Francisco • Seattle • Salt Lake City • Houston • Factory: Trenton, N. J. • Est. 1870

FASTER CUTTING

WET or DRY with the NEW HD 48 CLIPPER Masonry Saw

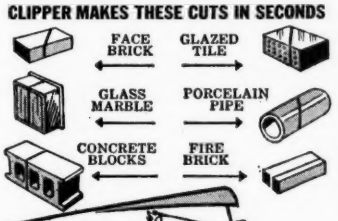
You'll be amazed how quickly and easily you can cut virtually any special length or shape from the hardest masonry materials. Clippers save time — save material, assure better workmanship on every job.



With the exclusive Clipper design, proven throughout the world and guaranteed to provide the fastest cutting speed and the lowest cutting costs.

DUSTLESS MASONRY CUTTING so fast and easy. Just turn on the circulating water system and slice through the hardest masonry materials. Foot Pedal control for varying material sizes or lock the cutting head at a set position, whichever is desired.

CLIPPER MAKES THESE CUTS IN SECONDS



FREE TRIAL
In keeping with our policy for the 10th consecutive year, you can have a Clipper on Trial. Clippers for Every Job priced as low as $195... write for Catalog, Today!

THE CLIPPER MFG. CO.
19 EAST 28th ST. • KANSAS CITY 8, MO.
PHILADELPHIA CLEVELAND ST. LOUIS AUSTIN, TEX.

by these diverse requirements is to be found through application of sound economic analysis. Objective No. 3 requires additional investment over the minimum. The operator specifies this requirement and is, therefore, responsible for placing a dollar value on profit loss due to plant shutdown. The designer can determine the investment required to prevent this loss. If the return is satisfactory, both the executive and operator are happy. An example is to be found in an analysis of turbine driven vs. motor driven, forced and induced draft fans shown in Table III.

Note in Table III that the cost of a plant shutdown is predominant. The return on the additional investment amounts to 30.3 per cent. The executive is satisfied to spend additional capital and the operator has made possible low operating costs by preventing plant shutdown.

Operating Costs Versus Investment

It is conceded that the executive, the operator, and the designer all strive for plants that will result in low operating costs.

The designer must use an economic measure and weigh cost reduction posibilities against the added investment required. The return must be adequate. An evaluation of two plans is shown, Table IV, to illustrate this point.

Plan A provides minimum first cost facilities and Plan B provides lower operating cost facilities which require a larger investment. The difference in operating cost yields only a 1 per cent return on the additional investment. It is significant that the depreciation charge for Plan B nearly off-sets operating cost advantages. The additional investment for Plan B did not yield an adequate return, and therefore the lower-first-cost, higher-operating-cost Plan was the most economical.

Problems Created by Fuel Characteristics

Supply, type, and characteristics of fuel introduces economic problems. Local dust ordinances, site conditions, and labor procurement problems introduce factors that must be properly evaluated. Vendor's proposals introduce problems requiring economic analysis. For example, a boiler manufacturer may propose an installation with a small furnace and stoker to be operated at the limit of heat transfer and burning rates in order to make a low bid. Although such low-cost equipment is desirable, it may require investment in dust-collecting facilities an may result in high operating costs because of limitations in fuel selection.

There are cases where low prices on individual units of a steam plant assembly have resulted in high over-all costs. It is the over-all cost picture that must be considered. There have

Is your problem heating . . . cooling . . . drying?

Read how this important new "tool" can be adapted to your industry.

HEAT PUMPS

By **PHILIP SPORN,** Executive Vice-President and Chief Engineer, American Gas and Electric Service Corporation; **E. R. AMBROSE,** Air Conditioning Engineer, American Gas and Electric Service Corporation; and **THEODORE BAUMEISTER,** Consulting Engineer, American Gas and Electric Service Corporation, and Professor of Mechanical Engineering, Columbia University.

Here is a complete, authoritative volume which offers an easily understood technical treatment of the development of the heat-pump. It tells the progress made in adapting it not only to building heating and cooling service, but also to such industrial processes as: the evaporation and purification of liquids, the drying of solids, and the simultaneous chilling and heating of process fuels. The book contains practical questions and data which those concerned with the development and use of this important new tool want to know.

Contents include:
Thermodynamic Principles; Basic Heat-Pump Designs; Design Factors; Equipment Design; Equipment Seltction; Defrosting Cycle and System Control; Industrial Applications; Economics of the Heat-Pump — Its Effect on the Power System Load Curve; Heat-Pump Installations.

188 pages
1947 $3.75

ON APPROVAL COUPON

JOHN WILEY & SONS, INC.
440 Fourth Av., New York 16, N.Y.

Please send me, on ten days' approval, a copy of Sporn-Ambrose-Baumeister's HEAT PUMPS. If I decide to keep the book, I will remit $3.75 plus postage; otherwise I will return the book postpaid.

Name .....
Address .....
City ..... State .....
Employed by .....

(Offer not valid outside U.S.)

PG-4-48

been times when sales engineers could have turned failure to success by proving that a high bid would result in lower over-all first costs and lower operating costs. This, of course requires a free exchange of information, which is not always permitted. Thus, the responsibility for economic evaluation falls on the designer. It might be a good business practice for the designer to advise equipment suppliers how much additional cost can be justified by a specific performance improvement.

Effect of Incremental Loads

The operator specifies plant load characteristics. These require careful study by the designer. Duty and load duration must be well defined, particularly where existing plants are being expanded. Incremental loads and the justifiable investment present difficult problems. Recently a plant expansion project was presented specifying the addition of boiler capacity duplicating an older unit. The specified load was based on short duration peaks.

Economic analysis of this situation indicated installation of boiler capacity to meet peak loads, with provisions for future addition of auxiliary heat traps when justified by increased loads. Several thousand dollars operating charges for depreciation and nearly $100,000 in capital expense would be saved or deferred until such expense could yield an acceptable return.

Designers often seek the ideal or mechanical perfection. Relative costs of component parts and their economic significance is occasionally overlooked or unknown. High investment costs occur under these circumstances. In order to assist in the evaluation of designs, a standardized investment cost classification has been set up. The classification consists of nine well defined systems, each pertaining to a definite function in the steam plant.

Table V shows a tabulation of these systems and costs resulting from the design of a 50,000 lb per hr coal-burning outdoor steam boiler plant. The costs are for labor and material. Overhead and provision for rising prices and wages have been omitted. Incidentally, this steam plant design is a radical departure from conventional practice and style. The cost reductions to result are important. Note for example, the low unit cost for Buildings, Table VI, Plan B, compared to the unit cost for conventional style buildings shown in Plan A.

Unit costs for several designs can be intelligently compared when cost estimates follow the standard classification.

It is not uncommon to have ideas introduced into designs to satisfy individual tastes and whims under the pretense of providing a "better job". Such ideas should be incorporated in actual design only if they adequately satisfy the per cent return test.

Table VI. Investment analysis of steam plant systems for Plan A versus Plan B, showing unit cost comparisons

System	Labor & Material $/Lb./Hr Steam Cap. Plan A	Plan B	% Reduction
I—Steam Generating	1.68	1.60	4.8
II—Fuel Handling & Storage III—Dust & Ash Handling and Storage	.62	.43	30.6
IV—Feed Water	.36	.31	13.9
V—Piping VI—Electrical Wiring	.83	.29	65.0
VII—Instruments & Controls	.16	.06	62.5
VIII—Building	.67	.10	85.1
IX—Misc Equipment	Nil	Nill	....
Total	4.32	2.79	35.4

full steam ahead with "NO-SLUDGE"

When too much fuel oil is consumed in relation to the power output—look for sludge at the bottom of the tank.

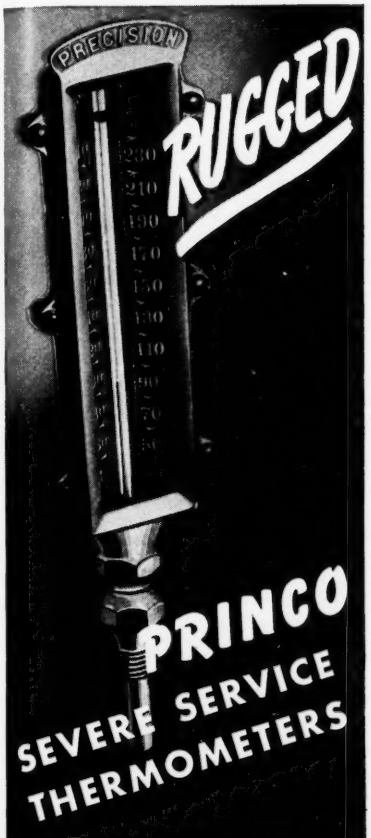
SLUDGE not only cuts down the B.T.U. output, but generally retards over-all boiler efficiency.

"NO-SLUDGE" Fuel Oil Treatment activates B.T.U.'s by putting sludge deposits into suspension, improves combustion, keeps burner nozzles clean, and eliminates rust and corrosion.

To get the maximum amount of B.T.U.'s per gallon of oil use "NO-SLUDGE."

"NO-SLUDGE" is fully Guaranteed. Write for full details.

Dominion CHEMICAL CO., Inc.
WATER CONSULTANTS AND CHEMISTS FOR INDUSTRIAL AMERICA
11 WEST 42nd ST. · NEW YORK 18, N. Y.
Canadian Distributor: THOMAS ROBERTSON & CO., LTD.



Here are the "PRINCO" Thermometers for those really TOUGH service conditions. Cases are extra heavy castings, specially designed for maximum strength. Frames and cases are BOLTED together. Glasses are extra heavy plate to withstand shock and vibration. Cases completely sealed against fumes and moisture. Built-in dehydrator prevents fogging or condensation. Extra protection for mercury tubes assures maximum service life.

Available in all standard case angles and temperature ranges, or to your specification. RED READING MERCURY or Canary-backed tubing optional. Wide selection of "Princo" Separable Sockets in a variety of materials. Write for full information and prices. Ask for Bulletin "E".

NEW! PRINCO "Easy-Setting" DIAL THERMOMETERS

5 Standard Scale Ranges
"Easy-Access" Cases for Quick Setting
Simplified Dial and Pointer Adjustment
Rugged, Accurate, Bimetallic Unit

Write for prices and additional information.

PRECISION
THERMOMETER & INSTRUMENT COMPANY

PRECISION INSTRUMENTS — PRINCO — FOR INDUSTRY

In Canada: PEACOCK BROTHERS Limited

1402 Brandywine Street, Philadelphia 30, Pa.

NEW NEMA CHAIRMAN

AT A RECENT meeting of the National Electrical Manufacturers Association, three Cutler-Hammer men were elected to NEMA chairmanships for the coming year.

Mr. F. A. Wright, Cutler-Hammer assistant general sales manager, was elected chairman of the advisory committee, Industrial Control Section. Mr. Wright has been active in NEMA for a number of years, having served previously as vice chairman and as chairman of the Industrial Control Section.

Mr. A. R. Johnson, Cutler-Hammer manager of merchandising sales, was elected chairman of the Knife and Enclosed Switch Section. He previously served as vice chairman of this section and as chairman of the advisory committee of the Knife and Enclosed Switch Section.

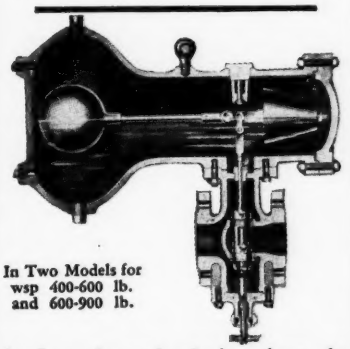
Mr. R. A. Millermaster, Cutler-Hammer assistant manager of development, has been elected chairman of the general engineering committee of the Knife and Enclosed Switch Section. He also has been appointed chairman of the general engineering committee, Small Air Circuit Breaker Section.

DR. JOSEPH SLEPIAN RECEIVES EDISON MEDAL

DR. JOSEPH SLEPIAN, associate director of the Westinghouse Research Laboratories, was awarded the Edison Medal of 1947 at the winter convention of the American Institute of Electrical Engineers in Pittsburgh, Pa. He was honored for his outstanding contributions to lightning protection, high-voltage circuit breakers, and other electrical apparatus.

Formal presentation of the award was made by Blake D. Hull, president of the American Institute of Electrical Engineers. Dr. Slepian is the 37th recipient of the annual award founded in 1909 to honor Thomas A. Edison. Past winners include Alexander Graham Bell, Nikola Tesla, and George Westinghouse.

Why the **STETS** *is*
FASTER ACTING!

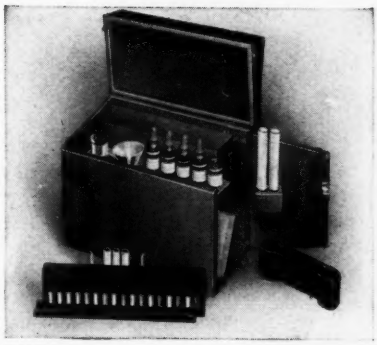


In Two Models for wsp 400-600 lb. and 600-900 lb.

As shown by sectional view above, the STETS High Pressure Feed Regulator is float operated. Action is based on change of liquid level only. The absence of a stuffing box between the valve and float chamber avoids any friction effect; assures faster response to minute changes in liquid level.

Write for descriptive Catalog No. 143; which describes equally efficient action of STETS low pressure regulators.

STETS COMPANY
1440 Broadway • New York 18, N. Y.



BOILER WATER COMPARATORS
Model P contains either High or Low Phosphate Comparator. Model W contains the same equipment plus 3 pH slides (pH7.2-8.8); (pH8.6-10.2); (pH 10-11.6) and accessories.

CHECK
BOILER WATER
pH and PHOSPHATES
QUICKLY...
SIMPLY
with a
TAYLOR
BOILER WATER COMPARATOR

A Taylor Boiler Water Comparator offers a fast, easy method for determing pH and phosphate — thus simplifying the control of corrosion and scale.

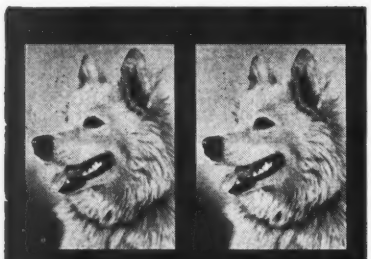
With Taylor Comparators no technical knowledge or experience is needed to make accurate determinations in one to two minutes. Because Taylor Liquid Color Standards are permanently enclosed in the slide, there is no handling of single standards. Accuracy is assured because all Taylor Color Standards carry an unlimited guarantee against fading.

Taylor Boiler Water Comparator base and slide are molded of durable plastic and the entire set comes in a convenient carrying case.

ASK FOR THIS FREE BOOK

See your dealer for Taylor sets. Write direct for this free booklet . . . 96 pages of detailed information on Taylor methods and equipment . . . theory and application in 34 basic industries.

W. A. TAYLOR AND CO.
7301 YORK RD • BALTIMORE-4, MD.



WHAT'S THE DIFFERENCE?

These Huskies look alike, yet hidden differences make one the born leader. In water too, looks are deceiving. To meet this condition . . . to give boiler users one water treatment that is effective against all impurities in any water regardless of composition . . . K.A.T. was developed.

ALL COLLOIDAL *K.A.T. WATER TREATMENT

Functions by physical action—not chemical reaction

Employed as a complete or "finishing" treatment, user records show that K.A.T. improves boiler efficiency • Removes and prevents scale accumulation • Inhibits corrosion • Safeguards steam purity • Lowers fuel, labor maintenance costs • Permits almost continuous boiler operation.

It will pay you to test K.A.T. in your own plant today.

Literature on Request

Representatives in principal cities

* T. M. Reg. U. S. Pat. Off.

AMERICAN K.A.T. CORPORATION
331 Madison Ave. New York 17, N. Y.

Gentlemen:
Please send me free descriptive literature on K.A.T.
Name.....
Company.....
Address.....
City.....State.....

SMOKE FORCE CUTS SOOT FALL ON CITY

CHICAGO'S SPECIAL smoke inspection force apparently has proved its worth in its first few months of work.

Figures released by Frank A. Chambers, head of the city smoke abatement bureau, showed a marked reduction in the city's fall of soot since the present staff of seven full time observers swung into action last year. Previously the bureau depended on residential complaints and the alertness of its other employees to catch smoking stacks and chimneys in the act.

In 1945 before the seven special smoke observers were hired, 198.23 tons of soot a square mile fell on Chicago according to dustfall meters at 23 measurement stations throughout the city.

Last year, after the nine months of special smoke investigation, the soot content of the meters indicated a fall of 179.43 tons a square mile.

For this year, the first with 12 full months of paid observation, the total (estimating for December) will have dropped to 139 tons, Chambers predicted.

HARRY E. WESTON BECOMES ASSOCIATE SECRETARY FOR PAPER MILL SUPERINTENDENTS

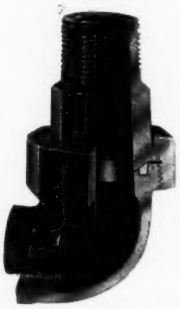
HARRY E. WESTON, for many years editorial director of *The Paper Industry and Paper World*, has been appointed associate secretary-treasurer of the American Pulp and Paper Mill Superintendents Association, Inc. He will be located at 38 South Dearborn St., Chicago, Ill., and assumed his new duties on February 16.

Mr. Weston entered the pulp and paper field in production work prior to World War I. He is a graduate of the New York State College of Forestry at Syracuse, N. Y., and taught pulp and paper-making courses there from 1920 to 1926. Follow-

JEFFERSON
Specialty UNIONS

Featuring the RECESSED BRASS SEAT

Save pipe joints and you'll save money



Savings in original installation through the use of Jefferson Specialty Unions is effected through simplification in piping and in the time and labor involved in making up joints. Once the installation has been made savings in maintenance are assured because there are fewer joints involved at points where unions can be most effectively employed.

The brass seating feature of all Jefferson Specialty Unions is insurance against shut-down because it assures leak-proof tightness without undue pressure. It can be made or broken without impairing the effectiveness of the seat. 90-degree Union Elbows are but one of the many types in which Jefferson Specialty Unions are available to save money and pipe joints. Consult us or your nearest distributor for further details.

JEFFERSON UNION CO.
601 West 26th Street, New York 1, N. Y.
Factories at Lexington 73, Mass., and Lockport, N. Y.

LET ALLADDIN FUEL OIL TREATMENT BRING YOU THESE OIL BURNING BENEFITS:

- Distributes sludge evenly
- Emulsifies moisture content
- Keeps fuel oil lines and burner nozzle clean
- Reduces soot and carbon deposits
- Increases boiler efficiency

Alladdin Fuel Oil Treatment is easy to use—disperses the sludge uniformly throughout the oil—inhibits the corrosive action of most fuel oils and tanks and equipment. Write for Descriptive Folder.

SOME CHOICE TERRITORIES STILL AVAILABLE

ALLADDIN LABORATORIES, INC.
68 William St., New York 5, N. Y.

PUMP SPACE LIMITED? *Install an* IMO

- The capacity of the IMO is increased by high speed operation. This compact pump can be directly connected to the driving machine without bulky speed reduction gearing.
- IMO Pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids.

Send for Bulletin 1-146-G

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2 NEW JERSEY

ing his teaching experience, he became a sales engineer, selling machinery to pulp and paper mill organizations throughout the Middle West and East.

In 1927, Mr. Weston became associated with Edward B. Fritz, Chicago, Ill., as advertising manager of *The Paper Industry*. In August, 1932, he was made editor and subsequently, through the combining of two magazines, editorial director of *The Paper Industry and Paper World*. It is from this latter position that he goes to the Superintendents Association.

Mr. Weston is the author of two books: Lectures on Pulp and Paper Mill Machinery; and a non-technical treatise entitled, A Book on Paper. In addition, he has written many articles on the manufacture of pulp and paper for the business press of the industry.

He is a member of both the American Pulp & Paper Mill Superintendents Association and T.A.P.P.I. He was one of the founders of the Chicago Professional Paper Group, and served as its president for two years, from 1944 to 1946.

In his new appointment, Mr. Weston will work with both members and affiliates in promoting project work and other activities for their benefit, and the benefit of the pulp and paper industry. He will work closely with George Craigie, Secretary-Treasurer, and the main office of the Association in New York.

MILLER RECEIVES WES AWARD

EARLE MILLER of Riley Stoker Corp., Worcester, Mass., has received a first award from the Worcester Engineering Society for his work in charge of the development of a new spreader stoker for that organization.

The award is given to a young engineer, under 35 years of age, for outstanding merit in carrying out a specific project for which he is responsible.

PIONEER TAKES OVER PUESCO

PIONEER Service & Engineering Co., 231 South La Salle St., Chicago 4, Ill., announces that it has acquired the business and personnel of Public Utility Engineering and Service Corp., as of January 1, 1948. This work consists of: Consulting and design engineering and purchasing, consultation and supervision of technical operations, analyses and reports on rates, taxation, insurance, depreciation and valuation, consultation and supervision of finance and accounts, agency for stock transfers and interest and dividend payments. Fred C. Kellogg is president and E. D. Uhlendorf is senior vice president of the Power Service & Engineering Co.

Magnetic Control of Industrial Motors, by Gerhart W. Heumann; 589 pages; 5⅞ by 9 in.; illustrated; hard cloth binding; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, 1947; price $7.50.

Design and operating engineers, plant and maintenance engineers, and industrial application engineers, concerned with industrial control equipment, should find this book a valuable reference. Instead of writing largely from the standpoint of the design engineer, Mr. Heumann places primary importance on the user's requirements. Where the design engineer usually concentrates on the mechanical arrangement of parts, a circuit, or device—the plant or operating engineer must have a knowledge of what control equipment can accomplish, what is required of a particular drive system, and what performance can be expected of various types of motors.

The author presents the fundamental information needed, as well as up-to-date coverage of such subjects as amplidyne control and a-c hoist controls. Electric motor performance, characteristics of con-

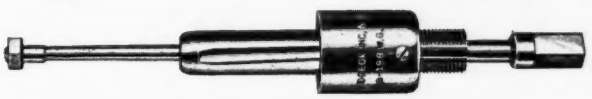
DUDGEON
HIGH EFFICIENCY
TUBE EXPANDERS

Available in all sizes!

DUDGEON Model 42 for Condensers Heat Exchangers Heaters Super Heaters Air Conditioners

Specially designed for rolling small tubes into a wide range of tube sheet thicknesses. Effective length of rolls variable. Tubes can be expanded full depth of a thick sheet.

It is particularly significant that during the emergency, DUDGEON — a century-old leader in the field — was called upon to develop and supply new types of tube expanders in great quantity for every type of domestic and foreign application. Through fulfillment of these unprecedented demands, DUDGEON can now assure prompt delivery of tube expanders to meet the most unusual requirements . . . at prices reflecting the benefits of greater production.



RICHARD Dudgeon INC.
MFRS. OF TUBE EXPANDERS SINCE 1853
24 COLUMBIA STREET, NEW YORK 2, N. Y.

Complete literature on Dudgeon products — expanders, hydraulic pumps and jacks — available. Write today, to Department

"Boiler Repairs Reduced 75%"
writes user of NATIONAL GIRTH SEAM PROTECTOR

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 928-29 REIBOLD BLDG., DAYTON, OHIO

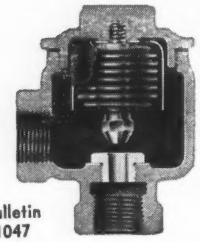
PLASTIK STEEL

WATERPROOF AND HIGH HEAT LINING
for ALKALINE, SULPHUROUS and
leakage protection of concrete or steel tanks, stacks or breechings has been time tested by industry.

This wonderful product, which is easier to apply than paint, has no fumes to contend with in application, and is now in service, on the high seas, in water tanks of ships owned by a world-wide oil company. PLASTIKSTEEL makes a tight and lasting bond.

PLASTIKSTEEL CORPORATION
1119 Lincoln Bldg., Los Angeles, California
330 South Wells St., Chicago, Illinois

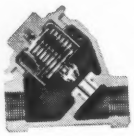
How to Keep Equipment FULL of Live Steam



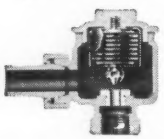
Bulletin 1047

Prompt and full drainage of condensate and venting of air and non-condensible gases are among the most important factors in maintaining maximum heat in coils, kettles, etc.

Two reasons why Nicholson thermostatic traps prove superior in test after test: (1) operate on lowest temperature differential, 5° to 15°, depending on trap size and steam pressure. (2) 2 to 6 times average drainage capacity. We'll gladly send one for testing.



5 TYPES FOR EVERY APPLICATION—power, heat, process; size ¼" to 2"; pressure to 225 lbs. Bull. 1047 or see Sweet's.



5 Features of Nicholson Cylinder Control Valves

(1) Special seats, don't cut out. (2) Fast, positive acting. (3) Stuffing box easily repacked. (4) Heavy-bodied, withstand abuse. (5) Neat, installed in any position. For all mediums: press. to 5000 lbs.

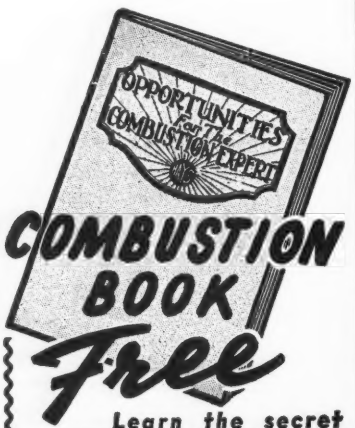
W. H. NICHOLSON & CO. 160 OREGON STREET WILKES-BARRE, PA.

trol devices, and the function of commonly used control circuits, is thoroughly explained. Emphasis is placed on consideration governing the selection of controllers to perform specific jobs.

Introduction to Mathematical Statistics, by Paul G. Hoel; first edition, 256 pages, 5⅝ by 8⅜ in., cloth; published by John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y., 1947; price $3.50.

Practicing statisticians in both industry and government will find in this book a comprehensive introduction to the theory and application of modern statistical methods in all fields of applied science. All of the more important material basic to these fields is discussed. For instance there are chapters on frequency distribution of one, two and more than two variables, on large sample and small sample theory, on testing goodness of fit and on statistical design in experiments. Going beyond the treatment ordinarily found in an introductory work the book also presents discussions of sampling inspection, nonparametric methods, testing statistical hypothesis against two types of error and sequential analysis. These fundamentals are carefully explained and demonstrated to provide a broad background for understanding more advanced concepts. Extensive references are given to aid the reader in pursuing any point of special interest.

Throughout the book emphasis is placed on the functional aspects of mathematical statistics. Many illustrative examples of both the numerical and theoretical types provide a working knowledge of statistical theory in various fields, clearly written to point up what is most important in the subject and effectively organized to integrate basic concepts. Introduction to Mathematical Statistics presents a broad introduction to classical, large sample, and modern small sample methods.



Learn the secret of BIG EARNINGS in . . .
COMBUSTION ENGINEERING

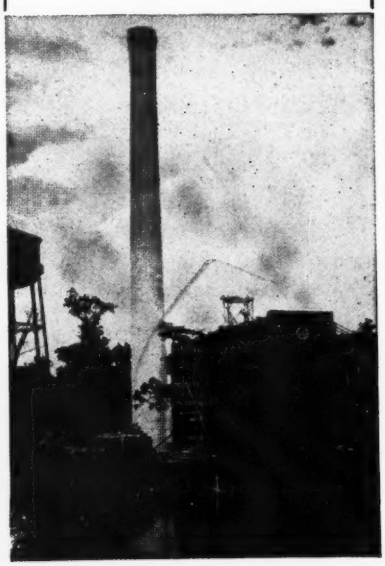
There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

Write for Free Book Now!

Hays Institute of Combustion
430 N. Michigan Ave., Chicago 11, Ill.
(Dept. 24) ***Our 28th consecutive year***

HAYS INSTITUTE OF COMBUSTION
430 N. Michigan Ave., Chicago 11, Ill.
(Dept. 24) Please send free book.
Name.....
Address.....
City..... State.....
Company Name.....

Consult Us For:
CHIMNEYS . . .
FURNACE WORK . . .
BOILER SETTINGS



AMERICAN CHIMNEY CORP.
143 Fourth Ave., New York 3, N. Y.
BRANCHES:
BOSTON • PHILADELPHIA • CLEVELAND
DETROIT • PITTSBURGH • CHARLOTTE

FOR YOUR FILTERS
BROMOX
WORKS WONDERS IN HARD WATER AREAS

- BROMOX cleans and sterilizes filter sand without removing sand from filters
- Changes calcium or sodium hydroxides to soluble salts leaving filters and piping easy to flush clean
- Cleans filter jets and breaks up colloids or mud balls
- Eradicates algae
- Is easy and economical to use

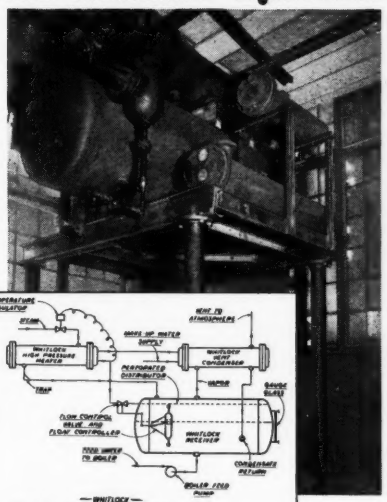
Write for data on what Bromox is saving in water filtering plants like yours.

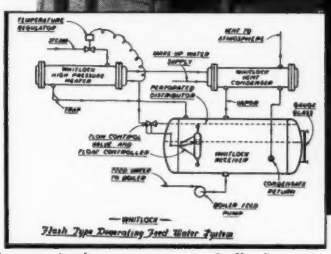
STERNE & MALEY CO.
WATER ENGINEERING
3604 S. MORGAN ST., CHICAGO, ILL.

PROTECT YOUR BOILERS AND AUXILIARY EQUIPMENT

WHITLOCK

FLASH-TYPE
DEAERATING
FEED WATER
HEATING SYSTEM





The Whitlock Deaerating Feedwater Heating System is designed to do a definite, specific job — and to do it well. This system reduces destructive gas inclusions to the required minimum and thereby precludes corrosion of boiler tubes, steam lines and auxiliary equipment.

The Whitlock System is extremely flexible, allowing the use of steam at different levels, and the amount of flash . . . and deaeration . . . is easily varied by adjustment of the temperature regulator. Simple construction, without internal complexities, keeps maintenance costs low. The Whitlock System has been developed in a full range of standard sizes to give optimum performance with all boilers from 50 to 2000 H.P.

Write for new Bulletin 120.

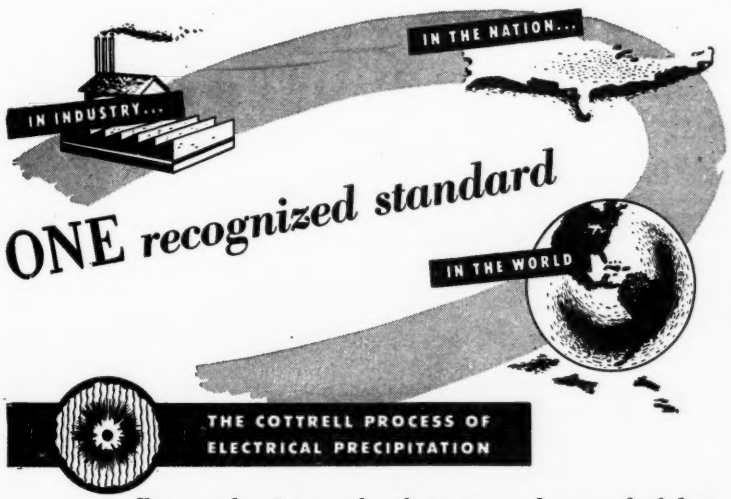
THE WHITLOCK MANUFACTURING CO.

47 South St., Elmwood, Hartford 1, Conn.

New York • Boston • Chicago • Philadelphia • Detroit • Richmond

Whitlock Heat Transfer Equipment

ESTABLISHED 1891 — AHEAD OF THE TIMES FOR HALF A CENTURY



For gas cleaning, smoke abatement and removal of dust, fume, tar and other suspended matter from gas, there has been one universally accepted process for more than thirty years. In answer to your special problem, a Cottrell installation incorporating this rich experience in research, development and worldwide operation means the complete fulfillment of your requirements.

RESEARCH CORPORATION

NEW YORK 17: 405 LEXINGTON AVENUE
CHICAGO 3: 122 SO. MICHIGAN AVENUE

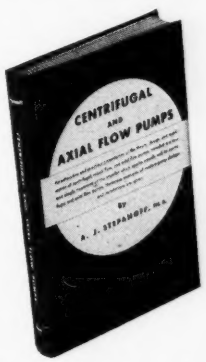
An exhaustive and complete working manual on . . .

Centrifugal and Axial Flow Pumps

By A. J. STEPANOFF,
Ingersoll-Rand Company

The rapid progress which has been made in the design and application of centrifugal pumps is given an interesting and practical account by this **leading expert. Centrifugal and Axial Flow Pumps** discusses both the theoretical and practical aspects of centrifugal and axial flow pump design. It also contains **original material** which will be of lasting value.

Theory, design and application form the three broad divisions. Starting with the theoretical background necessary for the understanding of recent developments, the author discusses impeller and pump casing design, losses in centrifugal pumps, axial thrust, cavitation, and pump shaft design for critical speeds. He also covers the problems encountered in the **actual operation** of centrifugal pumps.



1948 428 pages $7.50

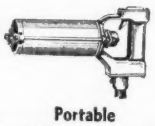
ON APPROVAL COUPON

JOHN WILEY & SONS, INC.
440 Fourth Ave., New York 16, N.Y.

Please send me, on ten days' approval, a copy of Stepanoff's CENTRIFUGAL AND AXIAL FLOW PUMPS. If I decide to keep the book, I will remit $7.50 plus postage; otherwise I will return the book postpaid.

Name .....
Address .....
City ..... Zone ..... State .....
Employed by .....
(Offer not valid outside U. S.) PG-4-48

Minutes
instead of Hours!
with
SYNTRON
CONSTRUCTION
and
MAINTENANCE
TOOLS


Portable
ELECTRIC HAMMERS

Portable
ELECTRIC DRILLS

Portable
GRINDERS—SANDERS

Whatever Your Job May be —

Drilling, cutting and chipping in concrete and masonry — drilling, sanding, buffing and polishing metal and wood — grinding welds and wire brush work —

SYNTRON has a modern, efficient tool to do it, and do it quickly.

Write for literature.

SYNTRON CO.

494 Lexington, Homer City, Pa.

GROSS VOLUME of $2,500,000 in research business for the 1946-1947 fiscal year has just been reported in its annual report for 1947 entitled, Partners in Research, by Armour Research Foundation of Illinois Institute of Technology. The report shows a 34.6 increase over 1945-1946. Just to give some indication of the type of things on which the foundation is working, which may some day be reflected in actual engineering equipment, here are a few of its activities:

Of interest and ultimate benefit to the general public as a whole is the work of the A-C Network Calculator Laboratory and Riverbank Acoustical Laboratories, the National Registry of Rare Chemicals, the Precision Gage Laboratory, the Ohmite Laboratory of Precision Electric and Magnetic Measurements. The foundation itself sponsors research in such things as the field of moderate and very high pressure phenomena, fluid flow and heat transfer in artificially roughened pipes, and vacuum treatment of metal.

Among the industrial research projects carried on by the foundation under the sponsorship of various industrial organizations, the following are typical: Development of Cutting Fluids; Development of Diaphragm Valves; Performance of Rotary Pumps; Stress Studies in Flue Gas Stacks; Volume Changes in Masonry Lingings of Steel-Jacketed Stacks; Refractory Coatings for Metals; Engine Deposits; Fly Ash Studies; Bakery Sponsored Study to Improve Pie Crust; Drying Methods; The Deposition of Solids on Turbine Blades at High Pressure; a number of studies in lubrication and lubricating oils, factory noise, elimination systems, V-Belts, etc.

Stop "Black Smoke" Expense
with a McNEILL ELECTRONIC INDICATING SYSTEM

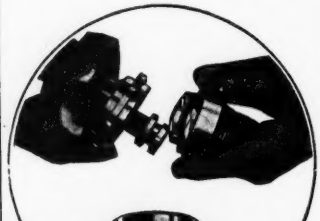
- **Remote indication for maximum convenience**
- **Alarm bell or visual indication when smoke is objectionable**
- **Instantaneous reaction**
- **Fits all types of boiler equipment**

Black smoke is a luxury no plant can afford. It represents fuel dollars going up the stack and leads to violations of smoke ordinances. Scores of plants depend on a McNeill Smoke Indicating System for a continuous and accurate check on conditions that affect fuel economy. This instant-acting, photo-electric system is easy to install; has a density meter reading from 0 to 100 per cent; may be fitted with alarm bell and signal lights; pays for itself many times over.

Send Your Specifications for a Quotation

Exclusive Sales Agents
TRIMOUNT INSTRUMENT CO.
37 W. VAN BUREN ST. CHICAGO 5, ILL.

Use VULCODISC
for trouble-free valve jobs



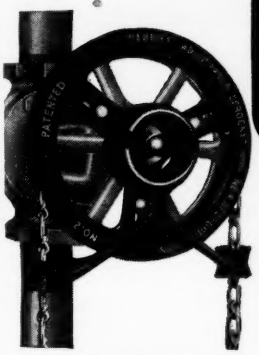
In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.

Dense without being brittle—tough, yet resilient. Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Makes ALL Valves *INSTANTLY* Accessible!



• Inexpensive BABBITT Sprocket Rims provide instant, handy control of overhead and other out-of-reach valves. Now — valves can be installed anywhere they should be, regardless of accessibility.

Babbitt Rims fit any valve, any style, with either rising or non-rising stems. Installed in a jiffy . . . simply by clamping directly onto hand wheel of valve. Do away with clumsy makeshift apparatus or specially-made chain wheels.

Ten standard sizes take care of all types and makes of valves; fit valve wheels from 2 to 30 inches in diameter.

•

Request Illustrated Catalog Bulletin PP, prices and name of local distributor.

Distributors in All Principal Cities

BABBITT STEAM SPECIALTY CO.
NEW BEDFORD, MASSACHUSETTS, U. S. A.

PRITCHARD offers the KEY to HIGHER PROFITS . . .

LOW-COST POWER

Benefit from our broad experience in the design, engineering and construction of UTILITY and INDUSTRIAL POWER PLANTS, either complete new stations or additions and alterations. Any part of our comprehensive service is available separately.

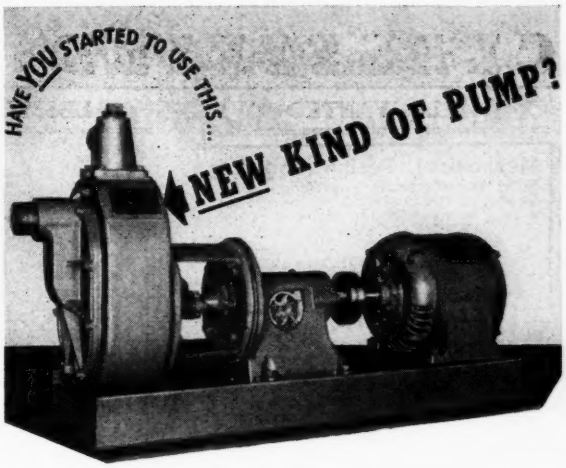
POWER DIVISION • FIDELITY BLDG. • KANSAS CITY, MO.

J. F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS
for the CHEMICAL, PETROLEUM, GAS & POWER industries

Offices in Key Cities Coast to Coast

Consult Sweets Files, Chemical Engineering Catalog, Refinery Catalog, ASH & VE Guide for full information.



More industries than ever now enjoy the advantages of centrifugal pumping—in processes where centrifugal pumping could never be used before. Here's the reason: a Marlow pump primes and reprimes automatically, dependably, on suction lifts as high as 25 feet.

The exclusive Marlow diffuser method of priming does away with auxiliary priming devices. With a Marlow, you can stop pumping a dozen times a day—or a hundred—and the pump reprimes and starts up again without being touched or adjusted in any way.

Or you can leave a Marlow Self-Priming Centrifugal "on the line" night and day—for this pump is built for continuous or intermittent service.

IT'S AN ALL-PURPOSE PUMP

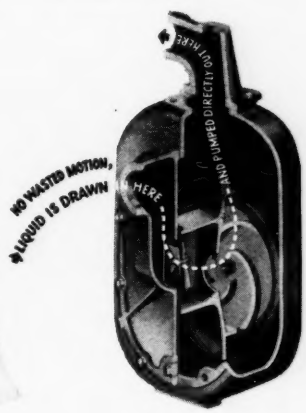
Clear liquid or gritty, heavy or light . . . it makes no difference to a Marlow. And even when handling volatile fluids, a Marlow won't vapor lock.

Wide choice of power, too: electric, gasoline, Diesel, or equipped for belt drive. Sizes from 1½- to 10-inch, with capacities of 50 to 4,000 gallons a minute. Sizes 2- to 4-inch offer choice of stuffing box or patented self-compensating mechanical shaft seal—a Marlow exclusive.

YOUR PROCESS IS DIFFERENT?

Marlow particularly welcomes inquiries from industrial pump-users whose problems are "different"—who want to be *shown* that a centrifugal pump can handle their work efficiently and at low cost.

State your needs briefly and full details will be rushed to you: Marlow Pumps, 574 Greenwood Ave., Ridgewood, N. J.



MARLOW PUMPS

RIDGEWOOD • NEW JERSEY

Manufacturers of Quality Pumps Since 1924

CLASSIFIED ADVERTISING

HELP WANTED

Mechanical Design Engineer
With administrative experience in the Design of steam electric stations. Preferably between 35 and 45 years of age.
LARGE EASTERN UTILITY
All Replies Strictly Confidential
Address Box 1602 Care of
POWER GENERATION
53 W. Jackson Blvd., Chicago 4, Ill.

ENGINEERS for Midwestern petroleum refinery. B.Sc. degree. Excellent opportunity for capable men. Give resume of experience and education in first letter. Confidential. Box 1606, POWER GENERATION, 53 W. Jackson Blvd., Chicago 4, Ill.

WANTED — YOUNG ENGINEER FOR ELECTRIC SYSTEM DISPATCHING
Large Northern New England Utility has opening for a young man with electrical engineering training who is interested in Power System Dispatching and Operating. Experience in hydro and steam generation preferred. Early interview will be arranged for qualified applicant. Address: Public Service Company of New Hampshire, 1087 Elm Street, Manchester, New Hampshire.

WANTED — Engineering graduate with some power plant experience to train for position as assistant boiler house superintendent in large industrial plant. Address Box 1611, POWER GENERATION, 53 W. Jackson Blvr., Chicago 4, Illinois.

WANTED — Large industry with expansion program has opening for a steam and electrical engineer, capable of design and installation of steam plant and electrical equipment with opportunity as plant engineer after construction period. Give age, education and experience in first letter with salary desired. Address Box 1612, Power Generation, 53 W. Jackson Blvd., Chicago 4, Ill.

EQUIPMENT FOR SALE

FOR SALE

The following used equipment, all in good condition, located at East Chicago, Ind.:

1—Westinghouse Stoker, 98"x8' 1½", single retort underfeed. 1500 lb. capacity hopper with variable speed stoker drive including constant speed motor and starter, also a size 2-W blower with Vortex control. 10 hp. Westinghouse motor 1650 rpm, CS 40 degree, 440 V, 3 hp., 60 cy., with class 11-200 starter. (Ref. B-12)
2—Westinghouse Stokers, 78"(F) x 7' 1½" single retort moving grate, underfeed stoker and one (1) clarage, size 1¾" W blower with Vortex control with 5 hp, 1750 rpm., 440 V, 3 hp. 60 cy., motor with class 11-200 starter, serial numbers 10058 and 10059 (Ref. E-69, E-70)
Stokers in service for only a short time.
1—Accumulator, 10" x 12' — inside ram type, W. H. Wood (Ref. E-109).
1—Worthington Hydraulic Pump. Size 4"x12" Serial No. D-94195 direct coupling, Smith & Serrill Co. Serial No. 44F217, 24-1¼", flexible pins, with 150 hp. motor, Gen. Elect. induction, Serial No. 1511929, Type 1 (Ref. E-110)
1—Worthington Hydraulic Pump, size 2¼"x12", Serial No. D92525, direct coupling, Francke Co., Serial No. 15056-16-1¼", flexible pins, with 75 hp. motor, Serial No. 11886 (Ref. E-111).
Also, approximately $400.00 worth of spare parts available for each pump. Accumulator and pumps are in service but can be released at once.
1—50 ton American Steam Locomotive, Serial No. 68528, std. gauge, age 17 yrs., (Ref. E-113).
1—45 ton Plymouth Flexomotive Diesel Mechanical Locomotive, Serial No. 3991, std. gauge, age 8 yrs. (Ref. E-114).

Offered subject to prior sale or other disposition.

For further details write:
General American Transportation Corp.
Machinery & Material Control Division
4405 Euclid Ave. • East Chicago, Indiana

SALESMEN & AGENCIES

SALES ENGINEER
IRON FIREMAN
Industrial-Commercial
COAL STOKERS
OIL BURNERS

If you can sell automatic industrial firing equipment to plant and building executives and engineers, this is an unusual opportunity. Complete line of nationally advertised underfeed and pneumatic spreader stokers, industrial-commercial oil burners and controls. Good knowledge of boilers and boiler plant equipment necessary. Permanent position and attractive salary to man selected. Reply by letter only.

IRON FIREMAN MFG. CO.
3171 West 106th Street
Cleveland 11, Ohio

WANTED
MANUFACTURERS AGENT
OR SALESMAN

For Indiana, Illinois, Arkansas and Missouri Territories. Capable of earning from $500.00 to $1500.00 per month, as our leading men are now doing, selling patented repair parts for diesel, steam and gas engines, ammonia and gas compressors and pumps. Our 36 years in business and money-back guarantee of satisfaction behind our products is your assurance of their salability. If you are in position to call on superintendents, operating engineers and purchasing agents of oil and gas pipe lines, power and light plants, ice plants, die casters, towing companies, steel mills, packing houses, etc., this is a real profit opportunity.

Our regular customers are listed among the foremost industries in the U. S. (Names furnished on request). Our men operate on exclusive-territory basis and receive credit on existing accounts from the day they start work with us. Due to nature of our business and demand for products, our three strategically located factories are producing at war time rate. We carry more than a million dollars worth of our products in stock for shipment upon receipt of order. In addition can make up and ship orders within 7 days.

Personal itnerview by Salesmanager will be arranged. When writing, please give age, experience, references and territory familiar with. Address, Box 566, Forth Worth, Texas.

SALESMEN: now calling on industrial plants will find little sales resistance with PLASTIKSTEEL lining for the protection of water tanks, stacks and breechings from alkaline, and sulphurous deposits. This side line to-day may be a main line for you to-morrow. Write PLASTIKSTEEL CORPORATION, 1119 Lincoln Bldg., Los Angeles, California or 330 South Wells St., Chicago, Illinois.

EQUIPMENT FOR SALE

BOILER PLANT
FOR SALE BY OWNER

5 — 312 H.P. each, Class XI, No. 16 B & W Stirling Type Boilers, 180 lb. gauge operating press.
Complete with Type E Stokers
Forced Draft Fan — Boiler Feed Pumps
Water Filters, Piping, etc.
Will sell as a whole or by units.

OTTAWA SILICA CO.
Box 437, Ottawa, Illinois

FOR SALE

750 H.P. Busch Sulzer, 2 cycle 4 cylinder Diesel Engine with 500 KW 440 volt, 3 phase, 60 cycle direct connected generator. In good operating condition.

CURTIS MANUFACTURING COMPANY
St. Louis, Missouri

FOR SALE

Combustion Engineering Company type "E" Stoker. In good condition. At present installed under 252 H.P. Water Tube Boiler. Cheap for Cash.

Address
RAINBOW LAUNDRY
Nashville, Tenn.

FOR SALE

One 50 KW 250 Volt Westinghouse Direct current Generator. Direct connected to Erie 10 x 10 engine. Engine or generator can be used separately. Good condition.

Write
AMERICAN LINEN CO.
150—26th St., Ogden, Utah **Phone 4655**

EQUIPMENT WANTED

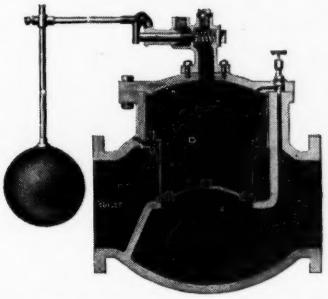
WANTED:
Coal-fired boiler, 50,000 to 100,000 lbs. per hour capacity, 400 pounds pressure or greater.

AMERICAN ENGINEERING & MANAGEMENT CORP.
4200 Board of Trade Building
Chicago 4, Illinois

Golden-Anderson

HIGH PRESSURE

Cold Water **Valves**

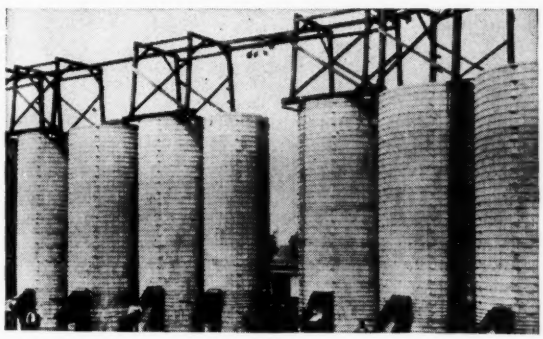


Needle valve control permits governing of closing speed to suit any operating need. Renewable cups and seat washer prevent metal contacts and make the valve very inexpensive to service and maintain. Write for descriptive technical catalog.

GA **GOLDEN-ANDERSON**

VALVE Specialty Company

PITTSBURGH 22, PA.



NEFF & FRY BINS SAVE MATERIAL HANDLING COST

Massey, Wood & West of Richmond, Va., store coal in ten Neff & Fry bins. Coal is hoisted into the bins with conveyors from dump pits, then loaded into delivery trucks by gravity.

Says the foreman, comparing this operation with one not so equipped, "We deliver more coal with half as many trucks."

Similar savings are experienced wherever Neff & Fry storage systems are employed in handling all sorts of flowable bulk materials. And because Neff & Fry super-concrete storage bins last a generation with virtually no maintenance, they pay for themselves again and again through savings.

You should get complete information from us if you're interested in the most satisfactory and most economical storage.

THE NEFF & FRY CO., CAMDEN, OHIO

NEFF & FRY STORAGE BINS

FOR MORE EFFICIENT SILENCING ---BE SURE IT'S A MAXIM

EXHAUST AND INTAKE SILENCERS

SPARK ARRESTOR SILENCERS

STEAM BLOW-OFF SILENCERS

Over the years Maxim has had the practical experience and research facilities to develop and build the finest silencing equipment available. Throughout industry Maxim Silencers have become a standard for many silencing jobs: on internal combustion engine exhaust and intake — compressor intake — vacuum pump discharge and steam blow-off. Maxim Heat Recovery Silencers recover waste exhaust heat to produce steam or hot water and afford the opportunity for a highly efficient hook-up. Maxim Spark Arrestor Silencers provide 100% positive spark arresting and are invaluable where a fire or dirt nuisance hazard exists.

Maxim offers a wide choice of standard silencers to fit the requirements of nearly any installation. The Maxim engineering department is always available to you for consultation and consideration of special silencing problems.

BULLETINS ON REQUEST

THE MAXIM SILENCER COMPANY

89 HOMESTEAD AVE. HARTFORD 1, CONN.

BE SURE IT'S A

MAXIM

ADVERTISERS

Air Preheater Corp., The..... 18
Alken-Murray Corp. ..... *
Alladdin Laboratories 138
Allen-Sherman Hoff Co..... *
Allen Co., Robert G. ..... *
Allis-Chalmers Mfg. Co. 30
American Blower Corp.....102
American Chimney Corp. 140
American Cyanamid Company.. *
American District Steam Co. .. *
American KAT Corp. 138
American Pulverizer Co. ..... *
Arkansas Fuel Oil Co. ..... *
Armstrong Machine Works..... 43
Atlas Valve Co. ..... *

Babbitt Steam Specialty Co. ...143
Beaumont Birch Company.....120
Beeson Brothers Engrg. Co. .... *
Belmont Packing & Rubber Co..112
Betz, W. H. & L. D..... 83
Bird-Archer Co., The..... *
Bros Boiler and Mfg. Co., Wm... *
Brownell Co., The..... *
Buell Engineering Co. ..... *

Cambridge Instrument Co. ..... *
Chapman Valve Mfg. Co., The..
.....Inside Back Cover
Chicago Metal Hose Corp. ..... *
Cities Service Oil Co. ..... *
Cleveland Fuel Equipment Co... *
Clipper Mfg. Co.....135
Cochrane Corporation 101
Combustion Engrg. Co., The..26-27
Crane Co. 41

Dampney Co. of America, The.. 96
Dart Mfg. Co., E. M.....110
Davis Engrg. Corp. 125
Davis Regulator Co. 128
Dearborn Chemical Co. ..... *
DeLaval Separator Co., The.... 25
DeLaval Steam Turbine Co..104, 138
Detroit Stoker Co.....20-21
Dominion Chemical Co., Inc.....136
Dowell, Incorporated 87
Drew & Co., Inc., E. F..... 19
Dudgeon, Inc., Richard.....139

Economy Pumps, Inc. ..... *
Edge Moor Iron Works, Inc. 93
Edward Valves, Inc. 4
Elliott Co. 2-3
Engineer Co., The 9
Enterprise Engine & Foundry Co.127
Erie City Iron Works..... 97
Everlasting Valve Co. 123

Fairmont Coal Bureau..... *
Falstrom Company ..... *
Farris Engrg. Co. ..... *
Fisher Governor Company..... 39
Flexo Supply Co. ..... *
Fluor Corporation, Ltd., The.... 37
Foster Engrg. Company..... *
Foster Wheeler Corp. 16-17
France Packing Co. ..... *
Fuller Company ..... *

Gamlen Chemical Co. ..... *
Garlock Packing Co., The..... *
General Coal Co. ..... *
General Electric Co. 12-13
Gifford-Wood Co. 31
Golden-Anderson Valve
Specialty Co. 145
Goodall Rubber Co., Inc. 134
Graver Tank & Mfg. Co., Inc.... *
Green Fire Brick Company, A. P. *
Grinnell Co., Inc. ..... *
Griscom-Russell Co., The.....103

Haering & Co., Inc., D. W.....132
Hagan Corporation 28-29
Hall Laboratories 22-23
Hays Institute of Combustion...140
Henszey Company 116
Huyette Co., The Paul B..... *

Illinois Water Treatment Co..... *
Infilco, Incorporated 106
Ingersoll-Rand Co. 117
International Nickel Co., Inc., The *
Iron Fireman Mfg. Co.....119

Jefferson Union Co. 138
Jeffrey Mfg. Co., The..... *
Johns-Manville ..... *

Keasbey & Mattison Co..... 32
Kellogg Co., The M. W..... 85
Kennedy Valve Mfg. Co., The..113
Kieley & Mueller, Inc. ..... *
Klipfel Mfg. Co. ..... *

Ladish Company ..... *
Leeds & Northrup Company.... 92
Link-Belt Co. ..... *
Liquid Conditioning Corp..... *

Marley Company, Inc., The.....105
Marlow Pumps 143
Maxim Silencer Company, The.145
McNeill Engrg. Co. 142
Metalock Casting Repair Service.130
Midwest Piping & Supply Co., Inc *
Milton Roy Company..... 90

National Airoil Burner Co., Inc... *
National Aluminate Corp..... 34
National Boiler Protector Co...139
Neff & Fry Co., The.....145
Niagara Blower Co. 118
Nicholson & Co., W. H.....140
Northern Equipment Co..... 49

Oakite Products Co.....131

Peabody Engrg. Corp. 99
Pennsylvania Crusher Co.....129
Permutit Co., The..... *
Plastiksteel Corp. 139
Prat-Daniel Corp. 107
Precision Thermometer & Ins. Co.137
Pritchard Co., J. F. 143
% Proportioners, Inc. %..... 6

Quaker Rubber Corp. 98

Reliance Gauge Column Co., The.115
Republic Flow Meters Co..... 24
Research Corp. 141
Richardson Scale Co. ..... *
Ric-Wil Co., The 91
Rockwell Mfg. Co..... 4
Ross Heater & Mfg. Co., Inc..... *
Roto Div. of Elliott Co.....126

Sarco Company, Inc. 45
Sier-Bath Gear & Pump Co., Inc.131
Simplex Valve & Meter Co..... *
Sinclair Refining Co..... *
Standard Oil Co. of California.. 47
Standard Oil Co. (Indiana)..14-15
Sterling Engrg. & Mfg. Corp..... *
Sterne & Maley 140
Stets Company 137
Stone & Webster Engrg. Corp... *
Strong Scott Mfg. Co..... 94
Syntron Company 142

Taylor & Co., W. A.....137
Taylor Forge & Pipe Wks..... 95
Templeton Brothers ..... *
Terry Steam Turbine Co., The..100
Texas Co., The.....Back Cover
Thermix Corp., The.....107
Tide Water Associated Oil Co... 89
Todd Shipyards Corporation
(Combustion Equipment Div.)133
Treasury Department ..... *
Trimount Instrument Co.....142
Troy Engine & Machine Co.....122
Tube Turns, Inc. 133

United States Steel Corp..... *
Universal Atlas Cement Co.
(Luminite Division) ..... *

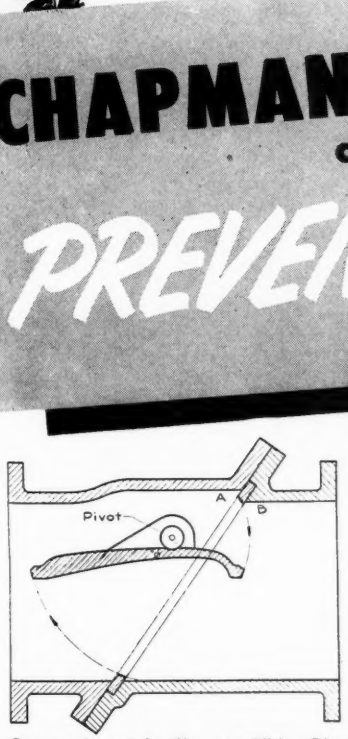
Vogt Machine Co., Inc., Henry.. 88

Wallace & Tierman Products, Inc.108
Warren Steam Pump Co., Inc.,..109
Western Precipitation Corp..... *
Wheeler Mfg. Co., C. H.....111
Whitlock Mfg. Co.....141
Whiton Machine Co., The..... *
Wickes Boiler Co., The..... *
Wiley, & Son, John.....135, 141
Williams, Gauge Co., The..... *
Williams Valve Co., The D. T...142
Wilson, Inc., Thos C.....114
Wing Mfg. Co., L. J.....124
Worthington Pump & Machinery
Corp. 33, 38, 121

Yarnall-Waring Co. 10-11, 50

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

CHAPMAN (TILTING DISC) CHECK VALVES are designed to PREVENT SLAMMING

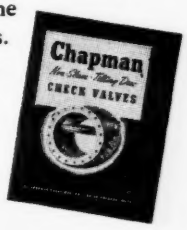


Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

Specially designed to prevent slamming and its consequent jarring of pipe lines, Chapman Tilting Disc Check Valves consistently cut maintenance costs. Because of the cushioning effect of the stream against the short flap of the balanced disc, they close quietly without setting up destructive pipe-line stresses.

Head losses are reduced as much as 65% to 80% over those experienced with conventional type check valves because of the design of the balanced disc. And when installed on pump discharge lines, they not only make possible increased pipe-line capacity but also effect substantial power savings.

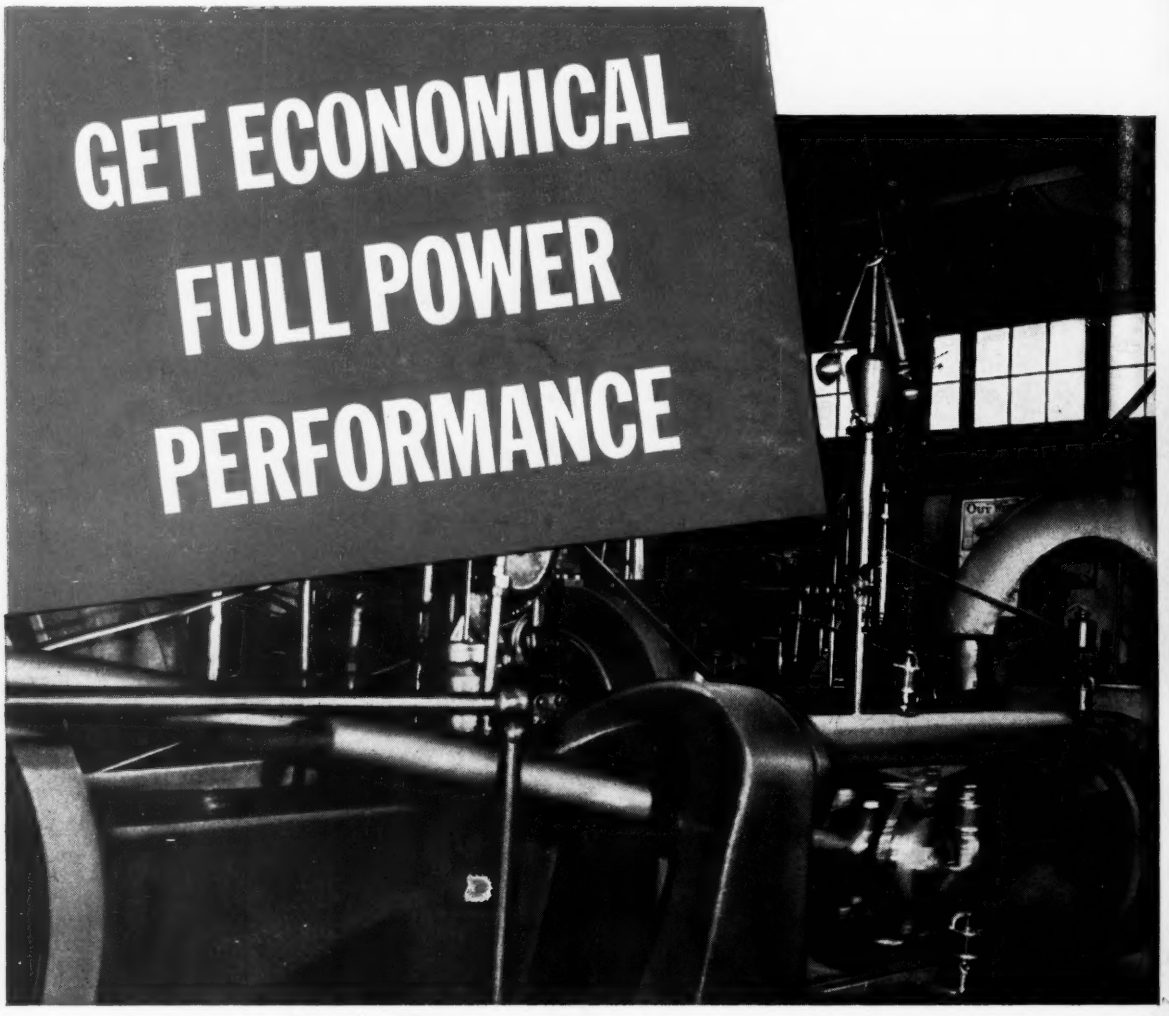
Chapman Tilting Disc Check Valves are available in steel or iron.



Send for bulletin containing engineering data and reports of tests.

The Chapman Valve Mfg. Co.

INDIAN ORCHARD, MASS.



Keep rings steam-tight with Texaco steam cylinder oils

For steam engines old or new — for every size and type — there is a Texaco steam cylinder oil to assure the most dependable operation at lowest possible cost.

Texaco steam cylinder oils atomize completely, resist wash-off, adhere properly to cylinder walls. They keep rings steam-tight, assure efficient valve action, provide thorough protection against wear. Use them — whatever your operating conditions—to get economical, full power steam engine performance.

A Texaco Lubrication Engineer will gladly assist you in selecting the most suitable Texaco steam cylinder oil for your engine. Just call the nearest of the more than 2500 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Steam Cylinder Oils

FOR EVERY STEAM CONDITION

TUNE IN . . . TEXACO STAR THEATER every Wednesday night featuring Gordon MacRae, Alan Young, Evelyn Knight: ABC Network.

TECHNOLOGY DEPARTMENT

Power Generation

INCLUDING Power Plant ENGINEERING ESTABLISHED 1896

PUBLIC LIBRARY
JUN 14 1948
DETROIT

MAY, 1948

Engineers' Preview 7
Helpful Bulletins 35
New Equipment News 42
What Leaders Say 53
Two Years' Operation at Jennison 54
By W. Greacen 3rd
The Venturi-Scrubber—A New Device for Cleaning Stack Gases 57
How to Use Color Control Tests for Boiler Water 60
By F. R. McCrumb
Taking the Mystery Out of the Amplidyne 62
By W. H. Wigington
Combination Alarm and Stalled Rotor Trip for Motors 65
By P. E. Benner
Standard Builds 1250-Psi Topping Plant for Whiting—II 66
By D. A. Monro and A. T. Milbrook
Breaker Interrupts 7½ Million KVA 67
Repairing a Steam Turbine Cylinder 68
By J. C. Blankenship
Mouse Traps Demonstrate Nuclear Fission 69
The Midwest Power Conference 70
Atomics
Mesons Produced by U. of California Cyclotron 72
By A. W. Kramer
THE PRACTICAL ENGINEER
Magnetic Flux Has Bearing on Power Plant Operation 74
By George Holman
So—You Are Going to Take an Examination! 76
By Cyril F. Greene
Thread Cutting in the Lathe 78
By Carl Thomas
Letters and Comments 79
Questions and Answers 81
Basic Guide to Ferrous Metallurgy 84
Control of Barnacle Growth in Condenser Intake Pits 86
By R. B. Lee
The Phillips Air Engine 88
New Engineering Books 100
Coming Events 110
Obituaries 110
Construction News 136

● ● ●

COVER: VIEW IN INDUSTRIAL POWER PLANT SHOWING POWER ENGINEER USING PHOSPHATE COMPARATOR TO TEST SAMPLE OF BOILER WATER. COMPLETE INSTRUCTIONS FOR THIS AND OTHER COLORIMETIC TESTS GIVEN IN ARTICLE HOW TO USE COLOR CONTROL TESTS FOR BOILER WATER. IN THIS ISSUE. (W. A. TAYLOR & CO. PHOTO)

e Magazine That Helps Men Responsible for Generation of Steam, Electricity and All Other Forms of Power Supply

Dressre

THIS 11,500-KW TURBINE-GENERATOR UNIT

is going through its paces on the Elliott test floor before shipment to an important southern utility plant for outdoor installation. It is one of a number of similar Elliott units, several of larger capacity. The turbine (which will later be heat-insulated and streamline-jacketed) operates on 600-psi, 825 F steam and has four uncontrolled extraction points for feedwater heating.

Elliott

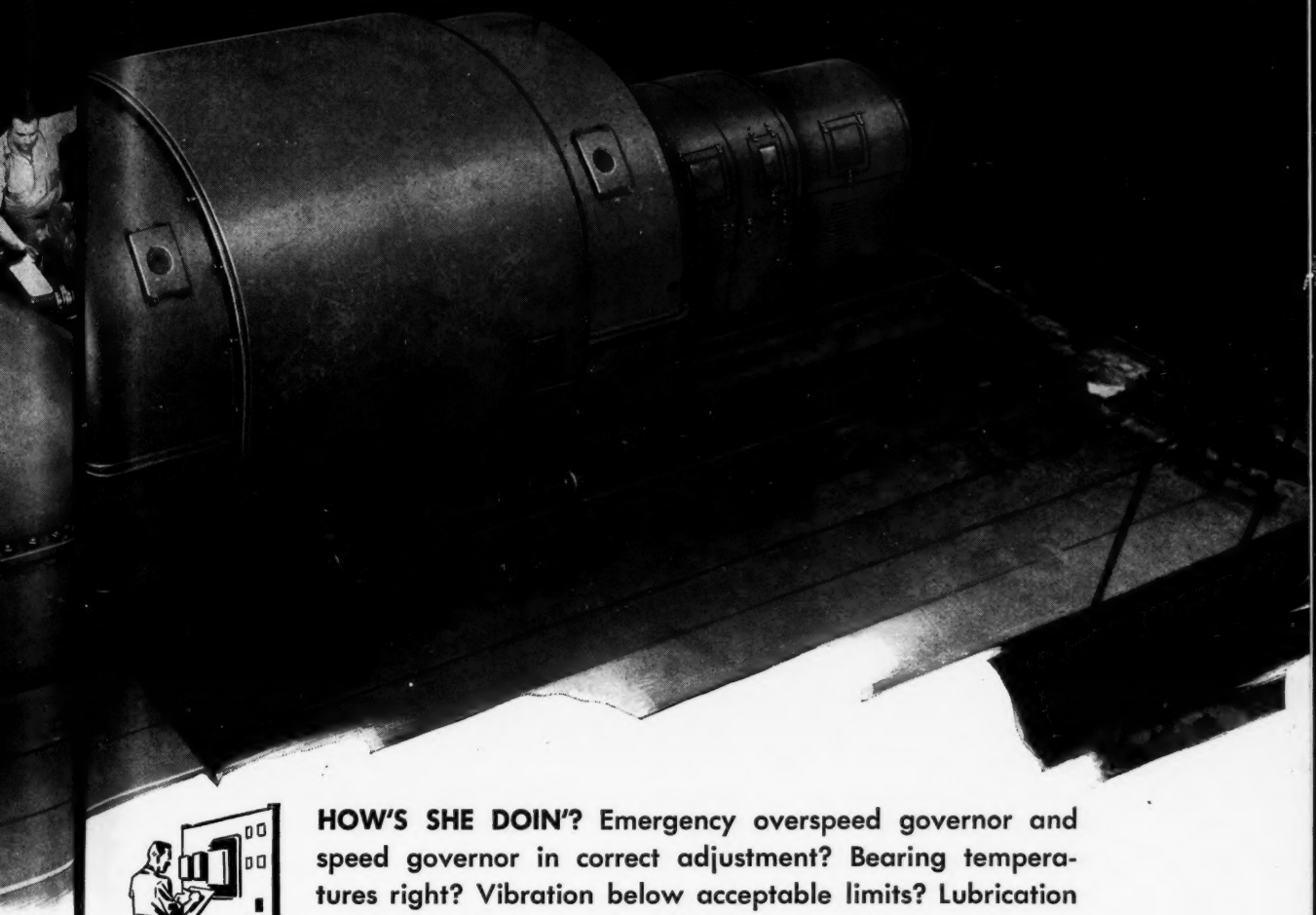
co

Steam

Plants at:

DISTRIC

ssrehearsal for 11,500 kw



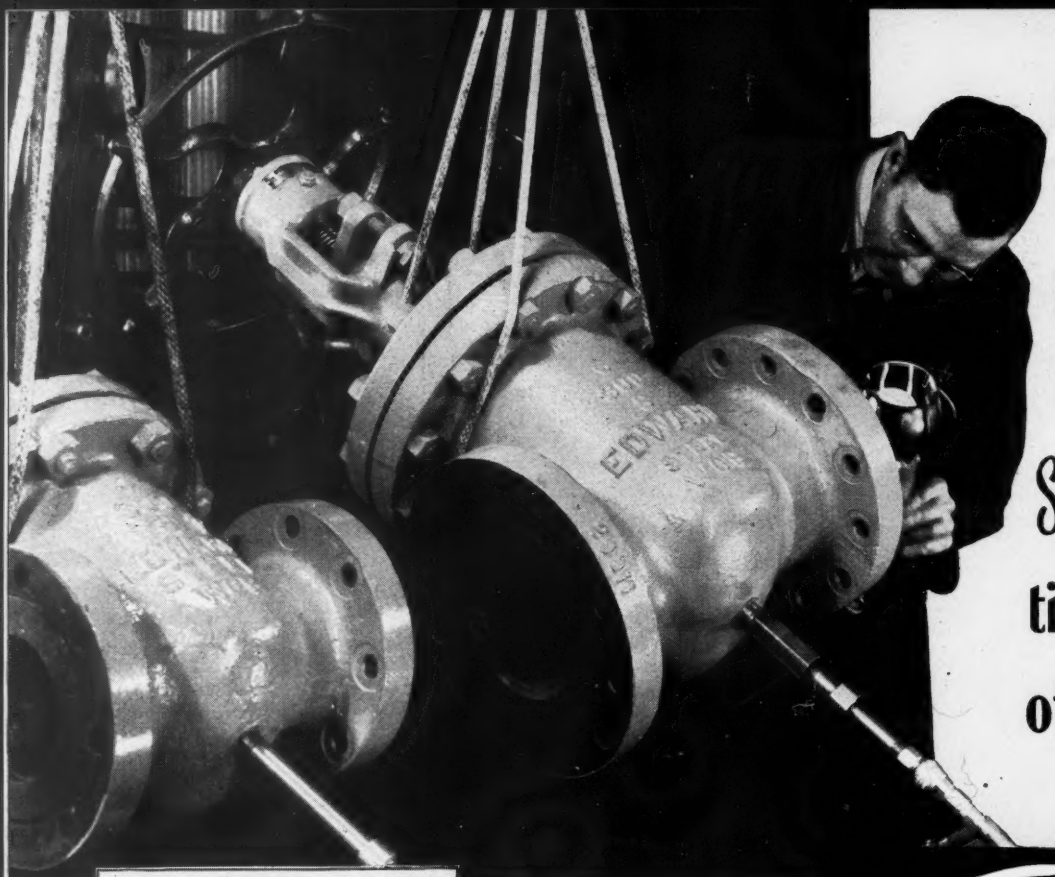
HOW'S SHE DOIN'? Emergency overspeed governor and speed governor in correct adjustment? Bearing temperatures right? Vibration below acceptable limits? Lubrication system functioning perfectly? All those questions and many more like them must be answered before this new Elliott turbine-generator is dismantled, given its final inspection, and shipped. The test floor is the final arbiter on all the careful calculating, split hair machining, meticulous generator winding, and the thousands of other processes which precede the assembling of a good-sized turbine-generator whose dependability is a **must.** The proof is in the instrument readings.

Elliott turbine-generators, built from turbine-inlet to generator terminals in the Elliott shops, are tested as carefully as they are designed and constructed.

H-715

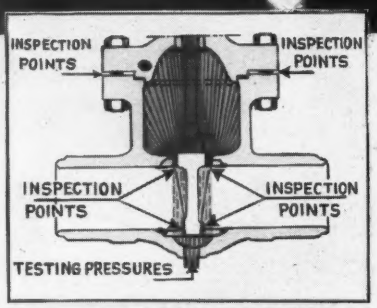
COMPANY
Steam Turbine Department
JEANNETTE, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • EXPANDERS • FILTERS

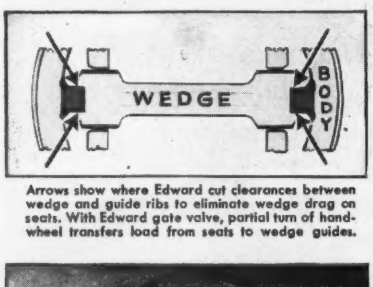


EXCLUSIV TEST METHOD PROVES Simultaneo tight seatin of both face of

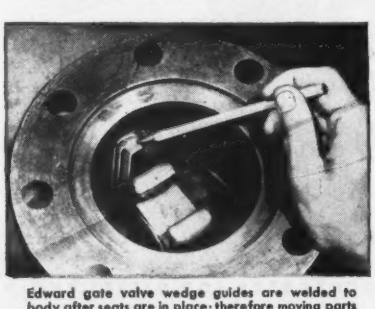
Edward GATE VALVES



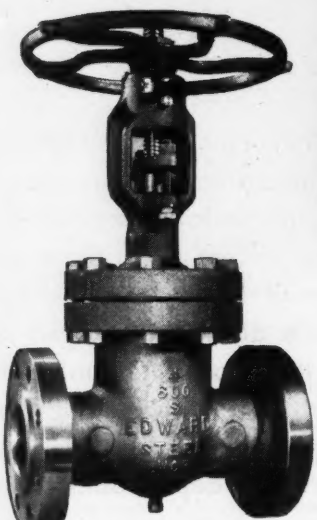
Pressure injected through the bottom of the body surrounds seats, yet leaves both ends open for simultaneous inspection in Edward testing method.



Arrows show where Edward cut clearances between wedge and guide ribs to eliminate wedge drag on seats. With Edward gate valve, partial turn of handwheel transfers load from seats to wedge guides.



Edward gate valve wedge guides are welded to body after seats are in place; therefore moving parts are accurately located. Seat rings are also welded in to prevent leakage between seats and body.



When Edward engineers began the design of a new series of steel gate valves they tested other makes. Many of them were tight on one seating face or the other, but few were tight on both faces.

To build really tight gate valves, Edward engineers discarded the conventional method of casting guide ribs as part of the body and instead developed a new technique for welding the ribs into the body *after the machined seating faces were in place*. This, they demonstrated, reduced machining tolerances, eliminated wedge drag on the seating faces, and cut wear. They were also sure it meant a tighter valve.

But how to prove it? The result was the testing method shown above. Now, *all* Edward gate valves are tested with both ends open for simultaneous inspection, and both seating faces must be tight simultaneously.

The new Edward gate valves incorporate many other plus-value features, such as welded-in seats, one-piece bonnets, ball bearing yoke bushings in most sizes, and Stellite faced seating surfaces. With Edward, these features are standard construction.

For more details write for Catalog 12-E.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO. EAST CHICAGO, INDIANA